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ABSTRACT

Teacher isolation is a significant problem in the science teaching profession. Traditional inservice solutions are often plagued by logistical difficulties or occur too infrequently to build ongoing teacher networks. Educational Technology Center (ETC) researchers reasoned that computer-based conferencing might promote collegial exchange among science teachers by giving them a new way to communicate with each other--individually or in groups, from their own workplaces and homes, at whatever time suits them. Using "Common Ground" conferencing software created at ETC, these researchers established an electronic network and conducted two initial studies of its operation. Researchers studied both technical and substantive aspects of the network's operation. Initial feedback from teachers was quite positive, and data on their usage patterns yield several findings: (1) some participants need support and encouragement in the initial stages of learning to use a conferencing system; (2) some participants encountered snags in setting up their own equipment or using their communications software; (3) access to equipment remains a problem for some school people; (4) inexperienced participants tend to send more private than public messages; and (5) forum moderators and/or a network coordinator can play an important role in stimulating and sustaining substantive discussions. Half of the document consists of appendices. They include magaine articles, case studies of teachers' use and evaluation of the network, sample telephone interviews, and sample network messages. (CW)

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FACILITATING COLLEGIAL EXCHANGE AMONG SCIENCE TEACHERS:

AN EXPERIMENT IN COMPUTER-BASED CONFERENCING

Technical Report

January 1987

Educational Technology Center
Harvard Graduate School of Education
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FACILITATING COLLEGIAL EXCHANGE AMONG SCIENCE TEACHERS:

AN EXPERIMENT IN COMPUTER-BASED CONFERENCING

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INTRODUCTION

During the past year ETC has explored the potential for a new computer-based conferencing system, Common Ground, to promote collegial exchange among high school science teachers. The project sprang from a problem pointed to in recent papers and discussions on the state of science education in secondary schools -- the isolation of science teachers from both ongoing developments in science and from colleagues with whom they might exchange ideas about the teaching of science (American Association for the Advancement of Science, 1982; Hooper, 1985; National Science Foundation, 1985).

Computer conferencing had served for over a decade as a medium for substantive discussion, supporting a strong sense of professional community among geographically dispersed groups (Kerr & Hiltz, 1982; Newell & Sproull, 1982; Vallee, 1984; Bankier, 1985). The size and expense of the computers on which the conferencing systems have typically resided, however, had limited computer conferencing to the worlds of business and technology. The few applications in education were designed for student use or stressed exchange of data and information. Although these are very worthwhile endeavors, conferencing had not made its way to the service of teachers for discussion -- of their subject matter, or of their practice. The increased availability of microcomputers and concern for the isolation of science teachers led naturally to the question of whether a conferencing facility would be of help.

The conception of conferencing for teachers included both "information sharing" and "discussion". By the latter, we hoped that conferencing could be a vehicle for staff development, to revitalize, rather than merely to inform, teachers' practice through engagement with other teachers and scientists. An emphasis on interpersonal dialogue is a goal of staff developers in business and education, as well as an interest of cognitive psychologists who believe that knowledge is born out of social interaction (Vygotsky, 1978). The project aimed to learn how teachers might use such a facility, given one designed thoughtfully from examination of past computer-based conferencing efforts.

Design of a Conference for Teachers

The experiment was designed with attention to both successes and difficulties found in past computer-based conferencing efforts. In the few examples then existing of computer conferencing for teachers, a number of problems had been reported. Two major difficulties noted by teachers participating in these programs were lack of access to equipment and feeling of intimidation by computers. Reportedly, many teachers felt that computers were "beyond" them, a perception exacerbated by poorly written manuals and conferencing software that is difficult to use. Facing these difficulties, teachers might be expected to give up before they have even begun with computer conferencing.

An encouraging counterexample, however, was the program of computer-based courses developed by the Western Behavioral Sciences Institute (WBSI). This program, designed for high-ranking business executives, generated thoughtful discussions between participants about difficult topics and resulted in ongoing computer conversations between members long after a course's completion. One of the most visible differences between this program and the computer-based conferencing then existing for teachers was the amount of attention paid to the human, non-technical aspect of the conference. Participants in a WBSI course met initially face to face -- establishing an initial group rapport. Professors for the courses were assisted by staff members who functioned as moderators for the conference by weaving participants' comments into an integrated whole and enumerating divergent opinions. The WBSI also took care to iron out technical problems as quickly as possible.

These and other examples suggested two design goals, and a third arose from our specific application and our concern for the network's subject matter:

- o Overcoming technical and logistical difficulties of using a computer-based conferencing system.
- o Thoughtful management and facilitation of group process on the system.
- o Means to stimulate and structure member's attention and contributions to the designated topics of the conference.

These three goals were carried out through both software development, described below, and conference implementation, described in the subsequent section of this report.

Design of New Conferencing Software

In the spring of 1984 an advisory board of six science teachers and administrators met with ETC staff and began to consider the design and focus of a conferencing system for science teachers. A new conferencing program, Common Ground, was written by Chris Hancock at ETC, and piloted among the six teachers in the spring of 1985. After some refinements of the program, a trial implementation for science teachers in eastern Massachusetts (the 617 area code), called the Science Teachers' Network, began in December 1985.

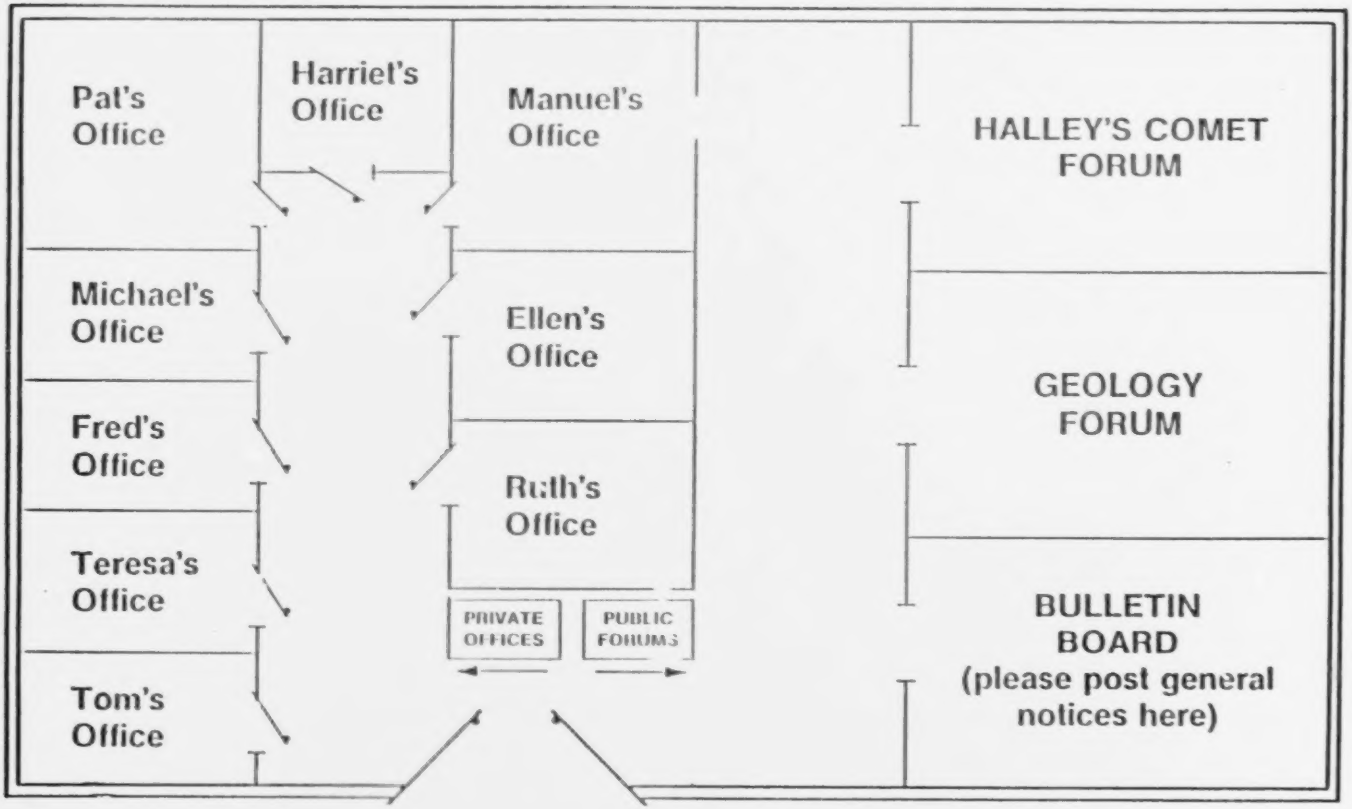
The decision to write a new conferencing system was based on a review of existing programs, which were seen to lack important features. Common Ground was developed at the Center to have several distinctive features: to run on a microcomputer; to facilitate discussion among an enrolled group of members (in contrast with a public "bulletin board"); to be easy for participants to use; to allow messages to appear as private messages, public messages, or both; to allow persons with only modest computer experience to run the conference -- as system stewards and topical discussion managers; and to allow collection of data for research purposes on log-ins, reading and writing. A fuller discussion of these features is found in the article in Appendix A which appeared in the December, 1985, issue of BYTE magazine (Hancock, 1985).

Since *Common Ground* runs on a microcomputer (currently, either a DEC Rainbow or an IBM PC or PC/XT (a hard disk is recommended but not essential), it is within the financial reach of most school systems. In addition, the system operators and managers can be people without extensive technical background, so that special personnel need not be hired in order for a professional educational organization, school district or state office to run a *Common Ground* conference for whatever purposes it might define.

Second, the program has all the essential capabilities of a true conferencing system, in contrast to a "bulletin board" system. While there is no sharp, commonly agreed upon distinction between a bulletin board and a conferencing system, there are several features that are omitted or only primitively implemented on bulletin boards -- making conferencing systems unique in their capacity to support discussion among participants. These include flexible ways of organizing messages by topic; controlled access, limited to enrolled members of the conference; and the capability for private as well as public messages.

The program has features designed to make intuitive sense to inexperienced users, both participants and system operators/managers. One problem with many conferencing systems is that they are difficult for the novice participant to understand and use. For example, the Participate system, used on The Source (a national information utility), is designed around a coherent but over-elaborate model which attempts to formalize the complex way that conversations can branch and merge. Other programs have a more reasonable level of complexity, but their features are not well organized. In *Common Ground*, the facilities are organized around a spatial metaphor which compares the entire conferencing system to a building with many rooms in it. Some rooms are private offices, where participants receive their private mail; other rooms are publicly accessible and serve as forums for discussion on a particular topic (Figure 1).

The duties of the System Operator, who handles the set-up and maintenance of the "host" computer, are easily executed in a *Common Ground* system. Although the System Operator has to have a general understanding of computers and be familiar with DOS, the command structure provided for System Operation and the accompanying documentation make establishing a *Common Ground* conference feasible for many people with a modest background in computer use. The functions of moderator and steward (who maintains "the building" through management of the membership and creating/deleting members and forums) are facilitated by commands which are also easy to understand and use.


Pat's Office
Harriet's Office
Manuel's Office
Michael's Office
Ellen's Office
Fred's Office
Ruth's Office
Teresa's Office
Tom's Office
PRIVATE OFFICES
PUBLIC FORUMS
HALLEY'S COMET FORUM
GEOLOGY FORUM
BULLETIN BOARD (please post general notices here)

SCIENCE TEACHERS' NETWORK
ENTER HERE
(members only)

Common Ground, the computer conferencing software used by the ETC Science Teachers' Network, is designed as a metaphorical building. Enrolled participants have access to their own private offices as well as member-initiated public forums and the network bulletin board. Being able to visualize the system helps members learn to use it quickly and easily.

Figure 1: Common Ground's Metaphorical Building

Research Design

Research on the network had three general goals: (1) to determine the extent to which the network succeeded in promoting collegial exchange about science and science teaching; (2) to identify the variables that influenced the extent and nature of conference use; and (3) drawing upon these findings, to develop recommendations about the best uses and management of computer-based conferencing among science teachers, among teachers generally, and for other possible educational applications.

We chose to pursue these goals through a broad descriptive inquiry for two reasons. First, there was no previous research on a system like Common Ground and it was unpredictable how teachers would use it. It was therefore inappropriate to narrow the research focus immediately to pre-selected research categories. The entire range would remain unknown and the significance of particular categories could not be interpreted without having the larger picture of the network. Second, the network was an event evolving over time and with multiple influences on its behavior. Understanding such a system required making observations over time, and the nature of changes over time would help to indicate influences on the system. We therefore chose a relatively more open-ended, ethnographic research approach which aimed to identify the range in message content, influences on use, and other features of interest, and then to assess the presence and extent of particular categories within the range (LeVine, 1970; Pelto & Pelto, 1978).

The observations and other data collection, and some hypotheses about influences on use, were guided by previous research on computer conferencing, related research in sociolinguistics, and by our own observations as the network evolved. These concerns fell again into the three categories of the original design principles: technical/logistical, social, and substantive.

In the first area, the effects of access to equipment on teachers' network use was demonstrated again in two additional studies (Barnhardt, 1985; Brochet, 1985). We collected data on equipment types, location, availability, whether or not connections between equipment were needed before each use, and kinds of difficulties experienced with software and hardware, as well as previous computer experience.

Secondly, many studies indicated that social factors deserved attention in research on conferencing. Most of these questioned the effects of the medium on social interactions. Crook (1985) raised the interesting but worrisome question of whether the seeming potential of computer conferencing for equal access to information is illusory. In an anecdotal report he commented that people reading a message addressed to a group may not feel as much obligation to respond as in face-to-face interactions or to personally addressed messages, and that information in a large conference may in fact be channeled according to pre-existing relationships.

If this were so, we felt that perhaps conference design and management could adapt accordingly. Perhaps pre-existing relationships could be used constructively to enhance rather than limit distribution of information and involvement of participants. There might be ways to integrate private and public mail facilities constructively and to use pre-existing acquaintanceships to advantage.

Other accounts led us to wonder whether the distancing of interactions in computer conferencing would be disinhibiting to social interaction, i.e. would in fact promote the kind of dialogue among teachers that was a goal of the project. Popular literature on electronic mail portrayed interactions as very free-flowing and uninhibited, and reported that people can make friends, even meet and marry through such communications. Reports from the EIES and CoSy network researchers on mainframe computer conferencing noted that exchanges are often very personal and highly emotional (Kerr & Hiltz, 1982; Swart, 1985). Therefore the project aimed to characterize the social quality of exchanges and learn what members felt about their communications with this medium.

In the absence of any evidence on the point, we wondered whether the most active network users would be those who were most professionally isolated, or those who were already active communicators. The finding here would have implications for choices of networking applications and for network management. If computer-based communications appealed only to the already active communicators, then administrative incentives and specific social facilitation would be needed in order for a network to reach those who tended to be reticent.

Finally, we were led by certain reports and our own observations to concern about the match of member interests with network purposes or topics. Some reportedly successful educational conferencing efforts were more activity-oriented, focusing on either specific activities being carried out as a group, or activities carried out by individuals separately in their classrooms but following face-to-face meetings. These included the WBSI program for business executives already described, networking for collaborative problemsolving in education at the Intercultural Learning network of the Interactive Technology Laboratory at UCSD (Cohen, Levin, Miyake & Reil, 1986; Reil, 1986), and following up of instructional innovations, as in the Alaska QUILL network (Barnhardt, 1985) and the New Jersey Institute for Technology's program for middle school teachers (Kimmel, Kerr, and O'Shea, 1986).

A final question (related to both social and substantive areas) concerned the need of the network for forum moderators and guests and what their roles should be. Since moderators and guests could be the major expense of a network, findings here would be important in planning of future networks.

As the study progressed, we sensed relationships among technical, social and topical factors: log-in frequency, membership size and diversity, and the stated subject matter of the conference. Specifically, we suspected that there may be alternative modes of exchange that have different requirements. If members' interests are diverse, and discrete information is wanted by members, an information-oriented network is called for. An information-oriented network might require a large membership size, or information databases, in order to increase the probability of an answer to a specific question. The greater the diversity of interests and specificity of information needed, the larger the membership required. In an information-sharing network, Thorngate (1985) has warned, if teachers do not find messages on their specific interests, their high workloads will cause them to lose interest after an initial period of curiosity. Furthermore, we surmised, in an information-oriented conference, the topic of the message is the critical factor in determining whether the reader will respond. The growth of network activity would therefore be very dependent on the match among member interests.

Common Ground, however, was designed to run on a microcomputer and for purposes of discussion, because we believed that the greater engagement between persons that occurs in discussions would best stimulate teachers' own thinking. A large membership might be a deterrent to discussion; discussion might require a small community of members who become well enough acquainted to feel comfortable offering their opinions to a group. Diversity of interests would be a problem for a small membership. A discussion-oriented network would be most successful if people already knew each other, especially if Crook's thesis was correct. The specific topic of a message would be less critical in determining the probability of a response than in the information-sharing network because the social norms that apply between acquainted people would encourage people to respond. Participation would also be enhanced by common activities among members, which would increase the commonality of their interests and purposes. As we observed the evolving discussions on the Science Teacher's network over time, and in doing the data analysis later, we developed a model of these variables which was the basis for making recommendations in several areas.

These interests were broken down into specific research questions which guided the data collection and analysis (Table 1). The three general goals noted above were addressed by different sections of the list:

I. Reduction of isolation, promotion of collegial exchange about science and science teaching: A, B, E

II. Influences on participation levels: A, C, D.

III. Conclusions and recommendations: all sections

Table 1

Research Questions for the Science Teachers' Network Project

A. How did members use the conference?

1. How and when did members typically log in?

   a. What computers and communications software were used?

   b. Where and how available were computer and phone line?

2. What was the range and typical amount of logging in, reading and writing in forums and private mail?

   a. Did these rates change over time?

3. What was the relation of membership size to writing activity over time?

4. What did people write, i.e. what were the topics of messages, what social functions were present, how discrete or general were the topics?

5. What kinds of exchanges took place in forums, e.g. were there questions followed by many answers, long chains of development of discussion topics, other other discernible patterns?

6. What did people read, and how selective were they in reading public messages?

7. Did members share information presented in network messages with others in the schools: did they solicit questions to put on the network from others?

B. To what extent did the conference succeed in providing information on science, science teaching, and new developments in science?

1. Of A.4 above, what percent of topics concerned science or science teaching?

2. Of A.4 above, what percent of topics concerned new development in science vs established knowledge of the field?

(Table 1, continued)

C. What can be identified as likely determinants of individual participation or nonparticipation, especially written participation?

   1. What difficulties did members experience using hardware or software, and were these related to participation?

   2. Are access to equipment, cost barriers, or reported shortage of time related to individual participation?

   3. Is previous experience with the relevant computing skills, including wordprocessing and modem use, related to participation?

   4. Are familiarity with other members, or professional activism, related to participation?

D. What determines the development of topical discussion in forums?

   1. What role does the moderator play in the development of forum participation and exchanges?

   2. What changes occur over time in the content and style of forum messages, and do these imply any antecendents to successful forum development?

E. What are members' views about the value of the Network to them, and about the best uses of computer-based conferences for science teachers?

   1. In their view, did the Science Teachers' Network meet their interests, and why or why not?

   2. Do members report gaining ideas about science or science teaching?

   3. Do members report that they got to know other members through participation in the network?

IMPLEMENTATION

In fulfilling the implementation principles listed above (p. 2), the project was guided by prior staff development experience gained at the Educational Collaborative of Greater Boston, a private nonprofit agency which provides a variety of professional development activities for teachers and administrators. The work emphasized developing a sense of community among members and understanding members' needs.

The implementation was also shaped by the limitations of project resources which were not sufficient to provide equipment or an 800 phone number to members. In addition, participation would be strictly voluntary, since no administrative support was available to offer incentives to participation as sometimes occurs in other staff development activities.

In the fall of 1985, letters describing the project, and application forms, were sent to all secondary science department heads and district administrators in eastern Massachusetts. These persons were asked to share the materials with any interested science teachers. The goals of the project were stated as "reducing teacher isolation from both current issues in science and from colleagues with whom they might exchange ideas about the teaching of science." The applicants were a diverse group -- from rural, suburban, and urban areas, teaching a variety of science subjects, and reporting many interests ranging from photography to robotics. The teachers shared one thing in common -- most of them used Apple computers.

When a teacher applied, he or she was sent a packet of materials including an application for a password, a Common Ground manual, a letter explaining the goals of the project, a survey of the subjects they taught and number of years teaching each, their computer equipment and phone access, and information about the research. Teachers received their passwords soon thereafter, but many teachers did not have the necessary equipment, or did not have it hooked up, until months afterwards. Teachers' first log-ins occurred throughout the period December to May, so the membership grew gradually.

The activities involved in establishing and running the conference included efforts both on the network and off to fulfill the implementation principles -- to overcome technical difficulties, to facilitate and manage group process, and to inform and structure conference content.

Activities to Reduce Technical Difficulties

Overcoming technical issues was a major goal in the start-up of the project and throughout this first year. Efforts included training sessions, the offer of online help, the Common Ground help command, the System forum, and the availability of assistance over the phone from STN staff.

Training Sessions

Two training sessions were offered. The sessions involved demonstration of and training in the basic procedures for reading and writing messages in _Common_ _Ground_.

Common _Ground_ "HELP" Command and Online Assistance

All participants had access to the _Common_ _Ground_ help command. This command can be used at all points while using the program to give information on the function of a command and how to use it. In addition, members of the Science Teachers' network were invited to schedule appointments with an ETC staff member to have online assistance, in which the staff member would guide the teacher through _Common_ _Ground_ in a synchronous interactive session from the "host" computer.

"SYSTEM" Forum

A forum named "SYSTEM" was set up on the network as a place for teachers to read and deposit messages about technical aspects of the network. Staff also used this forum to leave messages giving technical advice. This forum was useful because teachers used a diverse array of equipment and communications software and could discuss their questions and difficulties with others.

Telephone Assistance

In order to quickly eliminate technical difficulties ETC staff members encouraged teacher-participants to telephone ETC to ask questions and seek technical information. These phone calls were particularly important to those teachers unfamiliar with modems and communications software who needed assistance making their first call into the system.

Activities _to_ _Manage_ _and_ _Facilitate_ _Group_ _Process_

A second and equally important set of activities were those intended to help members become familiar with each other. Training sessions, moderators, a biography forum, and an online "whois" list all served to help develop the network community.

Training Sessions

In addition to providing instruction, the training sessions featured a guest speaker and additional time for members to meet each other and socialize. By structuring the meetings in this way we hoped to attract as many members as possible and to give opportunity for members to meet each other in person. We hoped these face to face meetings would lead to the development of a initial group rapport and subsequent network discussions.

Biography Forum

All participants in the network were asked to enter a biography in the biography forum. This forum was meant to serve as a place where members could search for others with whom they shared similar interests.

"Whois" List

The "whois" command is one which members can use while negotiating Common Ground in order to get a list of all the members with their codename, fullname and school.

Moderators

The WBSI work had emphasized the importance of active and structured moderation in producing successful group discussion. Feenberg (1985) described the role of the moderator as including two main functions: (1) maintaining participation and (2) preventing the fragmentation of discussion. He described a variety of ways to accomplish these functions, including norm setting, weaving conversation, and reinforcing participants. Therefore, after the initial start-up phase of the network, we asked for teachers to volunteer as moderators of a forum in their subject matter interest through a message in the "Notice Board" forum. Four teachers replied, and became moderators for the forums in chemistry, biology, physics, and earth science. Several general interest forums were moderated by ETC project staff. In Common Ground, the only technical facility that the moderator holds beyond that of the regular user is to delete messages; a much greater emphasis is given to social facilitation.

The teacher moderators started their work by meeting with the ETC staff to discuss how participation and discussion could be encouraged. The ideas that emerged were for both social and substantive facilitation -- including encouraging people who used private mail to post their messages in forums; noting when questions went unanswered, whether related points were going unnoticed, and bringing these up again in new messages or transporting the old messages forward; reinforcing participants; and introducing new members. The focus of these activities was necessarily on eliciting participation and establishing topics of interest to participants. The teacher moderators subsequently became among the most active of network participants.

Activities to Inform and Structure Conference Content

Sources of Science Information

There were, in theory, two sources for information on the science and science-teaching information we hoped would be the main focus of network communications -- the science teachers, and others who were science experts of various kinds. We believed that ideally the network would draw upon both sources and that they would complement each other. Teachers would be able to gain different but equally important kinds of information from their teacher colleagues and from the other scientists.

We also felt that the network might need to rely more on outside sources at the beginning, a time when teachers did not know each other well and might be more hesitant about engaging in free flowing questioning and answering.

Guests were selected on the basis of two surveys of members' interests, in which members were asked to describe the nature of their interests as well as specific individuals. These included topics and persons concerned mainly with science teaching, rather than science itself. Four guests subsequently participated: Robert Tinker, designer of microcomputer-based science lab software; Victor Schmidt, co-writer of the PBS "Planet Earth" television series; James Kaufman, consultant on lab safety; and Ralph Lutts, specialist in environmental education and Director of the Trailside Museum.

Another vehicle for presenting new information was the Literature Review forum where members voluntarily offered reviews of books and articles they had enjoyed or found useful.

Forums

The selection of forum topics was, by design of Common Ground, the major means to structure the content of discussions. What the forum topics were, and how they were initiated, is therefore one of the most critical characteristics of the network.

Three of the final forums were suggested by members of the preliminary 1984 pilot network at a planning meeting and were set up by staff during mid-1985. These forums were the Notice Board (NB); the Software forum; and the System forum. A fourth that was already established was the Teaching Forum, begun in August 1985 by recent graduates of the Harvard midcareer training program for math and science teachers so that they could keep in touch with each other as they began their first teaching jobs.

It was hoped that the teachers would themselves suggest the topics for additional forums by posting suggestions on the Notice Board, and a message encouraging these suggestions this was posted in that forum. When suggestions were not made, ETC staff started forums in each of the main science teaching areas: Biology, Chemistry, Physics, and Earth Science. Two other forums, Calendar and Biography, were initiated by the ETC staff. Finally, a Literature Review forum was suggested by the advisory panel of science teachers.

Separate forums were established for the first guests with the thought that this would encourage teachers to visit that forums. However, this did not turn out well for one of these, and the two subsequent guests were asked to participate in the appropriate subject matter forums.

The resulting forums and their functions are as follows:

-- The Notice Board forum (NB) served as a place to post general notices and to suggest new forums or topics of discussion.

-- Participants and ETC staff announced upcoming events in the Calendar forum.

-- The subject matter forums (chemistry, biology, physics and earth science) were places for discussion of the subject and the teaching of that subject.

-- The Literature Review forum was added as a forum for members to enter summaries, reviews, and citations of literature.

-- Members discussed software -- what's available, how to use it, what's good, and what's bad -- in the Software forum.

-- General issues involved in teaching, were addressed in the Teaching forum.

-- The TERC forum was established for members to discuss microcomputer based labs with guest Robert Tinker. Victor Schmidt, one of the developers of the PBS program "The Planet Earth", participated in the PBSearth forum with discussions of the program and related issues.

-- The Biography forum was established for each member to enter a biography describing their background and interests. This forum served to help members get to know one another by reading each other's biographies.

METHODS

Data collection was designed to provide information needed for the research questions but in some cases overlapped with information needed for implementation. For example, gathering information on members' equipment and interests allowed us to plan network activities and to provide better user assistance, as well as to document members' access to their equipment and learn their expectations for the network. Where research and service goals seemed in conflict, the decision was to maximize network success, even if this meant greater research difficulty. For example, understanding the factors underlying change over time in levels of participation or nature of discussion would have been easier if membership had been closed and no new members entering for a period of time. However, we chose to admit new members throughout the study because a larger membership might increase the probability of members finding others with similar interests.

Sampling

Time Period Studied

Data on network use cover the six month period from December 16, 1985, when passwords were issued to new teacher applicants, through June 18, 1986, the latest date at which data analysis could begin in order to complete the report on schedule.

Sample of Members

In order to understand the variation in teachers' use and opinions about the network, this information was collected on all of the participating teachers. The number of cases varies somewhat in the different sources of data described below. All who had been members for a long enough period to warrant analysis of their pattern of use (arbitrarily set at six weeks) were included in the analyses of teacher participation (n=58); of those, all who could be reached were included in the two phone interviews (n=54, 38); analyses of the effects of previous acquaintanceship on participation included all who returned the acquaintanceship questionnaire after two requests (n=40). Those returning the questionnaire had the same levels of participation as those who did not, so the sample was not biased for the purposes of these analyses.

To understand how teachers were using the network and what it meant to them, we also made case studies of four teachers, who were randonly selected from within the categories of dropout, low, medium and high participation (Appendix B). The analyses used all the information that was available on these teachers to draw a picture of the teacher's expectations and evaluation of the network, equipment and access, professional activism, and actual communications on the network.

Sampling of Messages

To understand the nature and content of network communications and their development over time, three forums of different types were selected for content analyses: one subject matter forum (Chemistry), and two which cut across subject matter areas but entailed different kinds of information (Teaching, and Notice Board). The Notice Board was designed for discrete information, while Teaching as a topic seemed to hold more potential for discussion to occur.

Procedures

Informed Consent

In the application materials and training meetings in which the goals of the research were described, members were also asked to participate in phone interviews and occasional questionnaires as a part of their membership. They were also informed that the content of private messages would not be recorded and that the only possibility of others seeing their private messages would be when one of the staff happened to read the screen on the "host" machine while the message was being composed.

Data Collection

Table 2 summarizes the relation of the data collection procedures to the elements of the research questions.

Record of Messages. Messages were printed out from time to time and collected into an archive for the study period. This printout was the basis for the analysis of forum communications, allowing study of the content of messages, the number of messages that occur on a given topic and how the topic evolved, and changes over time in other aspects of network interactions.

While reading a printout of messages can give an idea of the evolution of an interaction post hoc, it does not reveal how any one member experienced the interaction while logging in at a particular date. In one respect, this problem applies to analyses of all kinds of social interaction: reading a transcript of an interaction provides a different perspective from that of the participant at any one point in the interaction. But the problem of inferring the member's experience of an interaction is more difficult in asynchronous communications, and would also depend on the system used. In Common Ground, the command for reading messages defaulted to read all messages not yet read by the person logging in. The segment of the forum that members read at one time would depend on when they last logged in. The experience of a discussion might also differ depending on whether messages are read from the screen or printed out and read later, and other factors. Knowing what members experienced can be better inferred by studying exactly what messages he or she read and wrote over a series of log-ins, and knowing whether they were read from the screen or from a printout, and from staff member's observations of interactions as they were in progress. While

Table 2

Relation of Data Collection Procedures

to Elements of Research Questions

	PROCEDURE				
RESEARCH ELEMENT	Message Printout	Staff Diaries	Log Files	Teacher Interviews	Teacher Questionnaire
1. Content of communications	X	X			
2. Extent of participation			X		
3. Member's equipment and access				X	
4. Member's professional activism				X	
5. Member's previous acquaintance with network members					X

printouts are not suited for inferring how members experienced an evolving discussion, they are suitable for examining the evolution of the topics themselves, and changes in the social and topical content of messages over time.

Staff Diaries and Meetings. In February, three staff members began independent weekly observations and journals about the past week's network communications, focusing on "who talked to whom about what." These observations and weekly staff meetings helped the staff to synthesize their own thoughts about what was influencing the development of communications and how to improve the implementation. Their own use of the network also gave them experience with which to better understand teacher's use. The four central staff members had different, complementary training and experience: one in staff development and educational computing; one in social interaction and anthropological research; one in psychology and educational technology; one in software design, computer conferencing and programming.

Machine Log Files. In order to later analyze the extent and patterns of use, a program was written to accumulate information in the host machine on: session number, date and time of log-in and log-out for each session; message number, author and receivers of messages sent; message number of messages read. Thus a complete record was available of the time and duration of each session and what messages were read and written.

Interviews. Two telephone interviews were conducted with teacher members (see Appendix C). The first aimed to help them with any problems that they were having during the beginning of use, to document their equipment and access situation, to understand how and when they used the network during their day; and to learn about their professional contacts and activities, their opinions about the important difficulties of science teaching as a profession, and their opinions of network uses. This was conducted after the teacher's third log-in. The second interview was conducted during July for all members, and aimed to learn about several areas, through direct and indirect questions: how they liked the network, what interests they would express and whether and how the network had met them; whether they felt they had become involved in network discussions, had gained or used new knowledge about science topics or science teaching; whether others were in touch with the network exchanges through them, and any further recommendations they would like to make.

Questionnaire on Previous Acquaintanceships. At the end of the admission of members who would be included in the data analysis, around April 20, all science teacher members were sent a checklist survey asking them to rate each person on the membership list of the network as of that date in two ways: degree of previous "acquaintanceship" with that person; and perception of that member as an "expert" or not (Appendix D). The categories for the acquaintanceship scale were selected on the basis of Crook's (1985) comments that information in large computer networks may be channeled through pre-existing relationships, and that users may not feel an obligation to respond to a question from an unknown person addressed to a group. We elaborated this proposition to imply that, when a new member entered a large group of unknown persons, even a small amount of previous knowledge of another might make a difference in the willingness to begin interaction. Therefore the categories included: never heard of person; heard of person's name but never seen; seen person but never talked; talked with less than roughly five minutes; talked with more than five minutes. The second scale, perceived "expertize", relied on the member's own definition of "expert". We wanted to collect this information because we believed that a member's perception of someone as an expert might also affect their network reading or writing. Forty teachers returned this questionnaire after one request. In order to determine the reliability of the instrument, it was sent again about four weeks later to five teachers. The percent agreement between first and second administrations over 110 items ranged 91-99% for the Acquaintanceship scale, averaging 95% and from 90-99% for the Expert scale, averaging 95%.

Data Analyses

Levels of Participation. Teachers' participation in the network was assessed by using the data from the machine log files and deriving indices of logging in, reading and writing behavior. Because teachers had joined the network at different times, it was necessary to create rate scores in order to compare teachers with each other (e.g., dividing the teacher's total number of log-ins by the number of weeks from his or her first log-in to the end of the data collection period.). In addition to these participation rate scores, the pattern of a member's reading and writing was assessed, by computing the ratio of messages written to messages read, and the ratio of private messages to public messages. Since these rate and ratio scores were not considered to have metric measurement properties, and their frequency distributions contained outliers, only Spearman rank order correlations were used to assess associations between the rate and ratio scores and other variables.

Determinants of Participation. These inferences were based on the picture emerging from both qualitative and quantitative analyses. Some of the hypothesized determinants could be tested through correlational analyses using the participation rate scores and interview data that was easily and appropriate quantified. In parallel, we carried out qualitative analyses through our weekly observations of the network (reported in staff diaries and discussed at weekly meetings), and later through case studies of individual teachers and forums.

Forum Exchanges. Research questions A4 and 5, B1 and 2, and D1 and 2 required a method of describing the content of messages and nature of links between messages. We used a simple sociolinguistic analysis; the research goals did not seem to warrant the level of detail in description of language, topic and sequencing of social interaction that occurs in some discourse analyses and other sociolinguistic research. This approach used follows that originally developed by Hymes (1964), Goffman (1967) and others but with attention to social function and topic of a message as separately identifiable but intertwining agendae of interactions (cf. Keenan & Schieffelin, 1976; Katz et al., 1986). Each message was coded in four ways: topic; social function ("communicative act"); presence, absence, and nature of linkage to previous messages (through social function or topic); and presence or absence of science or science teaching content (a specific subcategory of "topic"). In describing topic and social function, three staff members did independent content analyses after preliminary discussions about the goals of the coding. This was to insure that whatever categories emerged would not be idiosyncratic descriptions but ones that three people with somewhat different perspectives would agree upon, in describing "what was happening" in network communications. The staff then prepared summary descriptions of the forums, which were compared. There was a very high agreement at the level of summary description, and a surprising amount of agreement in description at the message level, despite differences in the staff member's disciplines. Although topics were given slightly different labels, there was agreement on the presence of a topic, and the approximate number of messages on that topic. There was also strong agreement on what social functions were identified, and these overlapped with categories typically found in sociolinguistic research. This method was therefore judged to be an adequate means for arriving at characterization and comparisons of forums. The three forums analyzed here were each analyzed independently by two researchers, and the report below combines the two analyses.

Members' Opinions of the Network. The open-ended questions from the final interview were given a content analysis by one staff member; the interviews were also read as a whole to learn how members' goals and expectations of the network related to their evaluations of it.

RESULTS AND DISCUSSION

Members

By June, 115 persons were listed on the "Who Is" list of all persons who had been given passwords to the system. They included 75 teachers, 3 persons designated and announced on the network as special guests, and 37 others who were communications specialists or persons who wanted to try the network briefly and were given passwords as a courtesy. A few of these people had never logged in, logged in very infrequently, or did not write messages. The members who wrote three or more messages were a smaller group, about 50 persons.

Most of the teachers were very experienced: the mean and median number of years teaching is 13 years. Only 15% of the sample had taught for less than eight years. Almost half were currently teaching chemistry, and about a third were currently teaching biology or physics. One sixth were teaching earth science. Their subject areas are shown in Appendix E.

Other characteristics of the teachers are summarized in Table 3. About 40% used computers at home, 40% at school, 16% had computers accessible in both places, and 4% had to go to another school to log in. Forty percent of teachers reported that they incurred personal costs in using the network; but only 20% reported that costs decreased their participation.

About a third of the teachers had fully convenient access to their computer at home and without any burdensome costs to themselves. The others had potential barriers of cost or convenience of various kinds.

Nearly all teachers were already experienced in word processing, so they were not novices in use of microcomputers for writing, an essential skill in conferencing. Some were also experienced in telecommunications: 40% reported previous use of a modem, and 20% had experience in "uploading" -- preparing messages or data in a file before calling up the host computer, then connecting and sending the information -- and "downloading" -- saving messages in a file which can be printed out and read later.

When teachers were asked, "Do you find you have colleagues at school whom you talk to about science or science teaching?" only 11% reported that they did not. A greater portion, 35%, reported no such contacts outside of their own school. Teachers were also questionned systematically about the frequency of contacts, both formal and informal, with these colleagues. At their own school, most (82%) reported informal discussions with these colleagues averaging once a week or more often, and 57% of the teachers had colleagues who were teaching the same subject. Contacts in more formal settings at one's own school, such as department meetings, or staff development events, ranged from none to about once a week, averaging several times per term. Outside of school, only 18% of teachers reported informal contacts with colleagues as often as once a week. For the 65% of teachers who reported professional

Table 3

Teacher Characteristics

	n	%
Computer Access, Costs, and Skills		
Location of computer		
Home	18	41
School	16	36
Both	7	16
Elsewhere	3	7
Computer at home and no cost difficulty	12	32
Report that costs decreased participation	7	19
Report previous experience with word processing	45	94
Report previous experience with using modems	18	38
Report previous experience with uploading	9	19
Report uploading to Common Ground	10	21
Report downloading from Common Ground	17	35
Professional Contacts		
Report colleagues at own school	42	89
Includes colleagues teaching same subject	27	57
Informal contacts at least once a week	39	82
Formal contacts at least several times per term	21	45
Report colleagues outside of school	26	65
Includes colleagues teaching same subject	18	45
Informal contacts at least once a week	7	18
Formal contacts at least several times per term	16	40
Had previous interaction longer than five minutes with more than five other members	5	13

contact outside of their own school, the average frequency of both informal and formal occasions was several times per term.

While the teachers did report at least some collegial contacts in or outside of school, they did not know many of the network teachers or guests when they first logged in. The survey of previous acquaintanceships among members found that the median number of persons on the "Who Is" list that teachers had talked with before for five or more minutes total in all their past interactions was only two. They knew, on average, five additional persons by name or sight only.

Growth of Network Activity

New teachers and guests joined the network steadily between December and April, and about 60% of these continued to log in while the other 40% discontinued use either immediately, or after a few weeks. The distinction between "drop outs" and continuing users is not sharp because some members continued to log in, but irregularly and infrequently. The growth of total membership, net membership (subtracting cases of clear "dropouts"), and of message writing is shown in Figure 2.

While total membership continued to grow, net membership leveled off by March 1. The number of messages per week dipped below the net number of members five times, and three of these times coincided with school vacations.

We were interested in whether an optimal membership size could be determined from examination of the relation of net membership size to writing activity. We expected that message writing would increase in a logarithmic relation to membership size up to the capacity that the single phone line could handle, because there would be a synergistic effect in which a larger membership would allow more members to find more and more discussions that interested them. In addition, possibly a spirit of participation would develop and would be "catching". The results show that this is not the case; rather, message writing ran roughly in parallel with net membership. By looking at activity in the individual forums, and the number of members teaching that subject (not shown in figure), the same parallel relation was found.

How should this be interpreted? During the busiest period of the network, during March, the phone line was never busy more than 50% of any half hour period, and the typical probability of a busy signal was around 25%. Thus it is unlikely that message writing was ever limited by the capacity of the single phone line. Below we will develop an interpretation of this pattern based on technical, social and topical barriers.

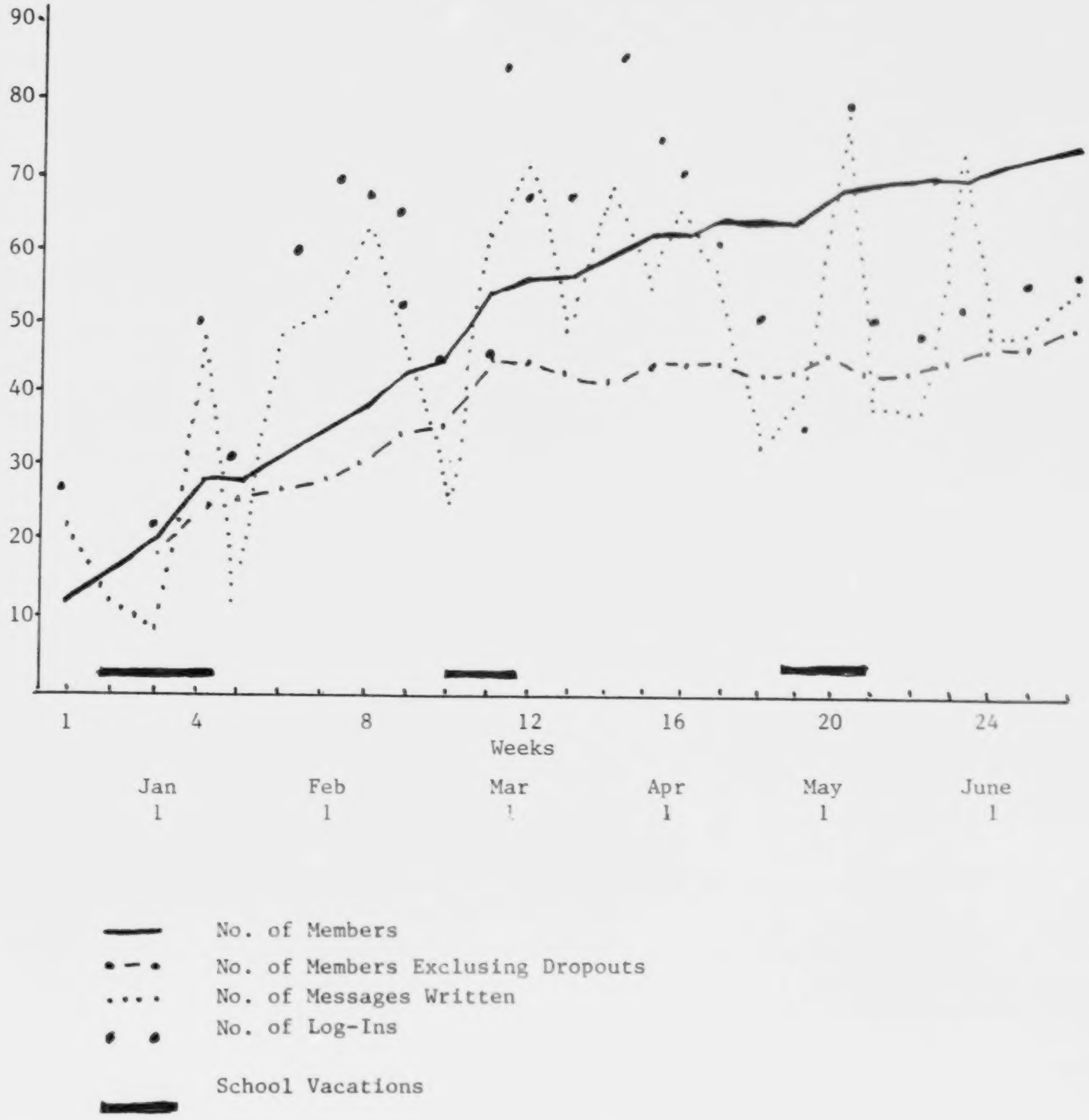
Public and Private Mail

Of a total of 2351 messages, 1479 (63%) were addressed privately, 684 (29%) publicly, and the remainder (8%) were addressed to both a forum and an individual. Most messages were sent to only one "address" -- only one forum or individual. The above ratio of private:public messages

Figure 2

Growth of Network Activity

Dec. 16, 1985 - June 18, 1986



probably obtained throughout the six months: the same ratio existed in January when 400 messages had been entered and only 29 teachers had logged in.

The motivating influence of private mail is apparent in teachers' interview comments and from other studies. In interviews, teachers noted the rewards of getting private mail: "it makes me feel important" and "I like getting a response to questions in my mailbox." Getting messages in private mail is believed crucial to a conference's success by EIES researchers (Kerr & Hiltz, 1982).

In the early weeks of the conference, the staff sitting next to the host machine noted conversations in private mail on topics that might interest others. In addition, the messages in forums often implied a prior conversation in private mail. Apparently teachers felt more comfortable writing privately than publicly at first. The staff wrote a forum message encouraging members to post their questions and comments more often in the forums, pointing out that a message could be addressed both to a forum and a person. From the final interviews, in which we asked teachers what kinds of use they made of private mail, they said they exchanged information concerning professional activities, like meetings to be attended. Thus private mail was apparently not used for strictly personal and nonprofessional matters.

The data we presently have does not separate out the messages of ETC staff in private or public mail, and this analysis is needed to pursue an hypothesis about a possible decrease in teachers' shyness over time. ETC staff (and the moderators) used private mail extensively to welcome members and to point out others with the same interests. (Some of these messages were addressed both privately and to forums.). Some of the private mail among staff was for internal communications about project management. When these are sorted out and the teachers' use of private and public mail studied over time we may have data in support of the initial shyness phenomenon.

Using the Network

Use of Software and Hardware

The first telephone interview with teachers revealed that they had very little difficulty in using *Common Ground*, but many had difficulty using their communications software and learning how to upload and download from their various computers and printers. In some cases, difficulties in knowing how to set parameters in the communications software prevented users from being able to log in to the network for months. Since teachers used a great variety of packages and combinations of equipment, there was little way for either the staff or teachers themselves to help each other with these difficulties. Staff worked as hard as possible to resolve these difficulties and also posted messages asking for advice in the System forum.

Uploading and Downloading

Using the procedures of uploading and downloading can create a radical difference in the experience of network use. Uploading saves phone costs since the message is composed off line in a word processor and the phone line is used only for sending the message. It also allows a very different style of network use, because the editing facilities of most wordprocessors are more flexible and extensive than those available in Common Ground (and other conferencing systems). Similarly, downloading messages saves costs and provides a different style of use: one is not pressed to try to read messages and think them over quickly while using the phone line; one can save messages to disc, print them out and read them later. In fact, it may be that only certain kinds of information can be comprehended easily from screen reading -- messages that contain only a few briefly stated points, and exchanges in which a series of messages on the same topic were entered in an uninterrupted sequence. When several topics are under discussion and are interspersed with each other, or when long messages are given, they are more easily read and understood from print. Twenty percent of teachers reported that they used uploading with the Science Teachers' Network, and 40% reported downloading.

Writing and Reading on the Network

What was the experience of the network like? Logging in to the network, what would one typically do? Observations of teachers' sessions on the host computer show that most members first read their personal mail, and then "scouted" the forums. The "scout" command showed the user the number of their new messages -- how many messaged had been entered into each forum since he or she had last read messages there. Teachers then "visited" forums that interested them, usually the forum in their subject area, and others, if they had time. Analysis of reading behavior from the machine log files confirms what was observed on the host machine: the most-visited forum of most teachers was the forum of their teaching area. However, about half of the teachers were "omnivorous" readers, visiting and reading in all the forums.

The experience of reading messages on the network, and how a member might experience any discussion occuring on the network, would depend critically on the time since the last log-in, whether all or only some new messages were read, and whether messages were downloaded and printed messages for later reading, or read from the screen. A convenient feature of Common Ground was that the two most frequently used commands, "scout" and "read", defaulted to display each individual user's yet unread messages. Thus the number of messages that would be displayed via this default use would depend strictly on the time passed since last log-in.

To illustrate network content, let us look at messages written during the week of April 7-13, which was typical in activity level. Logging in on April 7 and reading all messages to date, and then logging in again a week later, one would find the following listing to "scout":

physics	8	nb	3	system	1
caldr	4	soft	0	halley	1
earthsci	0	terc	1	teaching	1
pbsearth	0	litervie	3	biog	0
biology	2	chemis	11		

This shows a total of 32 messages in 14 forums; they are printed in Appendix F. To read all of these messages from the screen (at 300 baud) would take about 20-25 minutes. If you had logged in at higher transmission speed (1200 baud), saved the messages to a disc file and printed them out for later reading, the time for the phone call itself would be only about five minutes, and the later reading would again take about 20-25 minutes.

If the user had not logged in for two weeks, more messages totaling 825 lines would be found, which would have taken about 35 minutes to read from the screen. Thus the infrequent user who attempted to read many forums would be burdened by a large number of messages that would be impossible to read and digest from the screen. Some teachers mentionned this as a difficulty in interviews, saying that by the time they read all new messages, so much time had passed that they didn't have time to respond. A rough cost estimate for the 35 minute evening phone call at an average distance of teachers to Boston is about $1.25.

While *Common Ground* provides easy ways to scan and select messages for reading -- by forum, topic line, date, or sender -- the log file data suggests that members did not use these very often. If they wished to be selective in their reading, they visited fewer forums. The implications of these findings for network management are discussed in the last section of this report.

Content of Communications

The sample of messages in Appendix F is quite typical of the style and content of network messages. In general, the network was used for making inquiries, replying to inquiries and offering unsolicited information on rather discrete topics related to science teaching in the classroom, or within the science itself. There were very few messages about new developments in science; the most common topics concerned science *teaching*.

Comparing message content and types of interactions in the three selected forums shows notable differences between forums in the discreteness or generality of message topics and in the social aspects of messages. Whether these differences are related to the differing histories and social relationships that existed among forum members, or to the nature of the topics themselves, is an interesting question.

The Notice Board and Teaching forums both began during the mid-1985 pilot implementation, and certain messages were selected from each to make a "startup" forum in December when the new teachers began to log in. Four messages were selected to start up the Notice Board: three were an exchange between ETC and WGBH about the science videodics that WGBH was designing, and one was a request from a science teacher for ideas for design of science labs. The Teaching forum, on the other hand, had begun in summer 1985 as a discussion center for recent graduates of the Harvard School of Education mid-career program for the training of math and science teachers. It did not have the title "Teaching", but was called "Midcareer" after the name of the program that members belonged to. These people knew each other very well from their graduate work together, and the forum was developed as a way for them to keep in touch with each other as they began their first teaching jobs in September. Although only three persons and the program director entered messages between August and December 1985, those messages and interactions have a distinctly different character from the messages entered in other forums by science teachers who did not know each other. The messages have a large social component, such as greetings, reporting contacts with other members of the group, and offering help and sympathy. The topics of messages (other than the social content) were of a general nature, as is reflected in the topic lines assigned by the writers of these messages: "emotions"; "feedback"; "reflections". In addition, the messages followed a single evolving topic rather than several unrelated topics. Because the forum seemed to provide a good example of discussion, ETC staff left it on the network for the new teachers to visit even though the founders of the forum were a special group. The staff re-titled the forum "Teaching" because many of the messages were in fact about the teaching process, although the writers were using topics lines such as "emotions", or "feedback". At the same time, the midcareer training program teachers were given a private forum of their own to discuss issues that might not apply to science teachers more generally.

As the non-training program science teachers began to write to this forum, it still retained more generality and continuity in topics than other forums. In fact, a single, evolving topic can be seen to predominate throughout the Teaching forum, whereas in other forums, many topics of equal salience can be found at any one time. This topic began with a training program teacher's comment about feeling elated or depressed after successful or unsuccessful classes, and evolved to getting feedback on one's teaching, to problems of disciplining students and treatment of individual differences between students. The main contributors were a small group of persons including some of the training teachers and some of the STN teachers.

The information in messages in the Notice Board and Chemistry forums was more discrete in nature and did not reveal long continuity in topics. While this might be expected for the Notice Board, expectations for a Chemistry forum were not clear. The length of chains of messages on identifiable subtopics in the Chemistry forum is not long. Some of the exchanges took the form of a question with several answers offered, possibly an acknowledgement of response and comment, and then new question. Possibly the topics that teachers posed did not allow further development of ideas here. In the Chemistry forum, the messages focus on equipment, materials, and chemical processes: examples are fume hood, question banks, waste disposal, infared radiation, and freeze labs.

Although there was not lengthy development of ideas in the Chemistry forum, it appeared that members' contributions did spark off new ideas in others, as the "sociology of electrons" discussion illustrates:

> msg no. 2439 filed 9:21 Pm Apr 12, 1986
> from john
> to chemis
> re: sociology of electrons
>
> Anybody want to talk about this. My latest personal definition of chemistry is "The Sociology of Electrons:. There are species that demand to have them, flourine, e.g.; others that just as strongly strive to get ride of them, lithium, maybe. And many species that can take them or leave them: transition metals, C, N, S, etc.
>
> There are rules governing these behaviors, empirical for the most part, like sociology. Octet rules, electrnegativity, enthalpy change, free energy change, entropy, and the electrode potentials for redox reactions.
>
> There are numberless herds of these electrons and their behavior is governed only by statistical laws (with their inherent exceptions). And I'm not talking about the statistics of quantum stuff because I don't know all that much about that.
> So what, and who cares? It happens that my wife is a sociologist, so I care.
> I teach chemistry, my first love, and physics. I find in my department at Xxx H.S., and most of my colleagues agree, that chemistry is the single most difficult subject to teach. So cerebral! You're never going to see those electrons, those atoms, or those bonds. Physics, while usually considered to be more conceptually demanding, is far easier to teach because so much of it can be built upon prior experience of students in front of you. They already know about mass (call it "weight", maybe), speed, distance, and time. A physics teacher can build on this. But a chemistry teacher? Has to deal with the unknown and the unseen--and it will forever be unseen. So...the Sociology of Electrons. Haven't even yet discussed this with my wife-sociologist. I'm sure she'll have some input. Anybody want to talk about it? Glad to hear from you.
>
> msg no. 2479 filed 9:46 pm Apr 17, 1986
> from tyo
> to chemis
> re:sociology
>
> You struck a reponsive cord, John. I define Chem to my kids on Day1 as "The science that studies the comings and goings of electrons!" As to capturing their attention, try SEX! Males=metals; non-metals=females: hermaphrodites=metalloids; noble gases... alas, they're eunuchs!

I'm old and experienced enough so that I can get away with that analogy with my classes each year without embarrassing them or me!! And I must say they do remember it well!!

msg no. 2495 filed 2:55 PM Apr 19, 1986
from joe
to chemis
re: sociology of electrons

In my own chemistry teaching, I enjoy giving everyday examples of how ...behavior at the microscopic level is similar (not surprisingly) to the macroscopic level). For example, likes repell likes and opposites attrack is a common way to describe human couples.

msg no. 2500 filed 9:44 PM Apr 19, 1986
from john
to joe chemis
re: sociology of electrons

There's lots of stuff possible here.
Take Pauli's exlusion principle and compare it to no two human beings being exactly alike (even if they are identical twins).
2) Electrons love to go in pairs, and who doesn't want a friend?
3) tyo had a message about metals=male (giving away):
nonmetals-=females(receiving), and even more.
4) Fair market value in redox reactions: if you don't give the right # of e's, you won't get the right # of e's.
5) ....in general, some species have to dump them (Na, etc.), some have to have them (addicted ?), F, e.g., and some could care less, about taking them in or dumping them, Cu, Fe, etc.

Overall, since the couple of weeks or so when this furst occurred to me, I have had a little fun with the comparisons. But then, I've had to have second thoughts about an "exact" physical science, i.e. chemistry, taking its principles from an inexact social science, i.e. sociology.

But then, too, knowledge is whre you find it. And we are in the business not only of learning and knowing science, but in teaching it. And if this could help teach it...then do it!

Another difference between the Chemistry Forum and Teaching Forum is in the social functions of messages and the kinds of references to oneself, the writer. From the beginning, the Teaching forum messages are highly social in character, to be expected since the forum was founded so that persons who had been in classes together for a whole year could keep in touch as they became geographically separated. The messages also contain more references to thoughts and feelings of the writer -- in fact, these are the keywords entered in the topic lines by the writers themselves. In the Chemistry forum, references to one's personal experiences emerged gradually -- first in the form of little stories about something that happened to the writer. Only later on, and among several active participants, are expressions of opinion and affect found.

The three forums were about equally popular reading matter: about half of the teachers read all messages in each of these. Note also that the goals of the two forums, as stated by their founders, were quite similar. The goal of the Science Teachers' Network, as stated to applicants, was similar to that of the Midcareer forum founders -- to keep in touch and to engage in collegial exchange. What then restrained the development of discussion in the Chemistry forum compared to the Teaching forum? Can we draw any lessons for future conferences that aim to promote more teacher involvement?

Here we venture into the dangerous waters of attempting to explain differences between two naturally occurring events (Campbell and Stanley, 1963; Means and Cole, 1981). There are a myriad of differences between them and no way, within the data, to prove the causes of differences. In this situation, an explanation must be recognized to derive from prior assumptions and evidence rather than only from evidence within the comparison. We will proceed acknowledging that we are generating theory not testing it.

In this comparison, we do have a little leverage by looking at changes over time, which support a social hypothesis: that the greater initial familiarity among the Teaching forum members and their explicitly social interests led them immediately to more interpersonal engagement. The other teachers needed time to become familiar with each other and to feel comfortable about revealing their personal views. This explanation, however, leaves out two influences that may need attention -- the technical and topical. Kerr & Hiltz (1982) have stated that computer conference users need time to learn how to use the medium because visual feedback is absent. Furthermore, the topics have different implications and possibilities that may lend to different use. The first label of the Teaching forum was not a topic for discussion at all but a group identity label -- "Midcareer". The initial highly social exchanges took place under this label. As a "teaching" forum, it still lacks the subject matter specificity of the label "chemistry". The label "teaching" derives from a verb (process) rather than a subject (content), etc. Furthermore, in choosing where to write what, the "chemistry" forum was the clear choice for any subject matter specific questions; so we would expect more points of specific information there.

Our interpretation of the differences between the forums is that all of these influences were present -- that it was easier for the unacquainted teachers to talk first about simple points of information and "facts", because they were unacquainted, and because they were not completely comfortable at communicating in the new medium. The label of the Chemistry forum also made specific questions appropriate there, but did not restrict it to that use. The fact that, later on, more subjective "ideas" and matters of opinion and reflection emerge, interspersed with continuing exchange on points of information, is evidence that some teachers do want to engage in this kind of exchange and will use computer conferencing for this purpose.

The capability of the system to support *interaction* is shown in the social functions that can be identified in forum messages. The Chemistry and Teaching forums both contained a strong component of "exchange" in that many messages contained responses or comments to earlier questions or points. When messages are classified as containing the following functions (which emerged from the data) -- (a) seeking information; (b) answering a request for information or responding to a point; (c) offering unsolicited information or ideas; (d) other -- almost a third contain (a) and almost half are (b). The fact that this amount of responding occurred among unacquainted persons was surprising to us and seemed to demonstrate that a goal of the implementation, and of *Common Ground* -- to encourage exchange -- was being fulfilled.

Levels and Patterns of Use

One way to assess participation is by how many times members logged in. To adjust for the fact that some users joined later than others, the total number of log-ins of each teacher was divided by the number of weeks from the first log-in to June 18, resulting in a log-ins per week score. Of the 58 teachers who had logged in by May 1 (excluding teachers who were in the special role of moderator), log-in rate followed a steeply sloping distribution with many teachers showing a low log-in rate (see Figure 3). Many of those with low rates were "dropouts" who joined early. To understand frequency of use by the more regular users, let us look at the 32 cases who logged in seven times or more. Half (16) logged in less than once a week on average. Of the remainder, half (9) logged in one to two times a week, and the remainder (7) logged in more than twice a week, the maximum rate being eight times a week. Thus about a quarter of all teachers logged in at the rate of once a week or more; these could be considered the dedicated users, whereas others were only occasional users, or "dropouts."

Reading rate and writing rate also varied widely, and were correlated with log-in rate at about .7. About a quarter of teachers wrote one or more messages per week, while the average was one message every two weeks. The average number of messages read per week was five.

A different index of participation, and one that is not correlated with any of the above rates, is the relative proportion of reading and writing of each user (Figure 4). Among the 58 teachers, the ratio of messages written to messages read ranged from 4 to 138. The teacher at the latter extreme, the greatest "reader", had logged on 51 times over 17 weeks and had read 968 messages but written only 7. The "writers", at the others extreme, include John who was a member for 16 weeks, read only 77 messages and wrote 20, and Alex who read 754 messages and wrote 157 during 14 weeks. Most teachers (17/25) read ten or more times as many messages as they wrote. A quarter were active writers, writing one message for every eight or fewer read.

Another important index of use which helps us to know how well the network information reached teachers is the proportion of all network

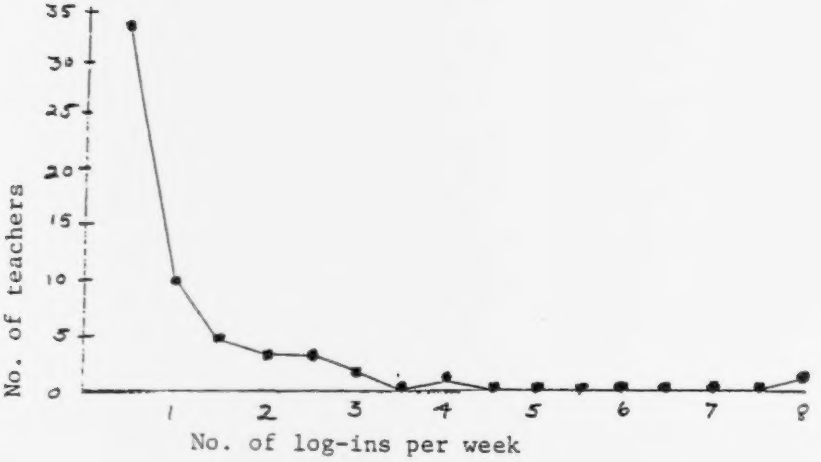


Figure 3. Distribution of log-in rates.

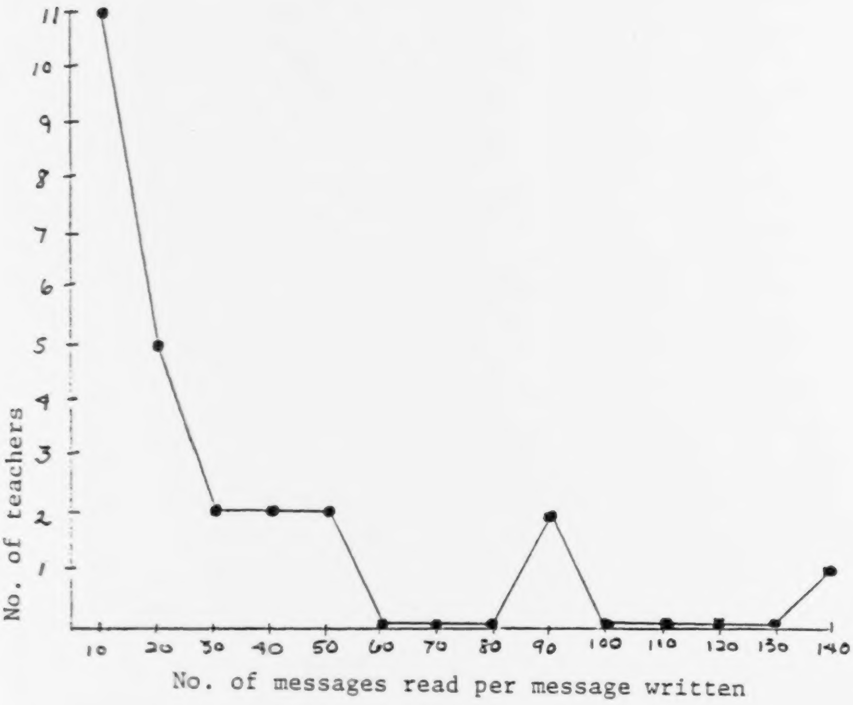


Figure 4. Distribution of messages read/written

messages that members read. To compute this in the least time-consuming way, we selected teachers who were members for a minimum of four weeks and were active during June (n=20), and noted the percent of all forum message that each of these teachers had read. Eighty percent of teachers had read more than half of the messages in the forum of their teaching area; 60% had read all of the messages in their teaching area. In addition, about half of the teachers read 100% of all forums. Further, some teachers had read two or three times the actual number of messages in a forum, indicating that they had downloaded or reviewed the messages more than once. The "omnivorous" readers were all frequent users, logging in once a week or more often.

The major finding of these indices is the wide variation among members. On each index, about a quarter of the teachers were very active participants while the others were occasional users or "browsers" who read much but wrote little.

While these participation figures represent how much use teachers made of the network, use does not correlate with evaluation of the network as revealed in the final interview. Teachers who had used the network infrequently reported that they found it extremely valuable and useful. What, then, explains the wide variations in participation? The following analyses supplement the forum analyses above to explore further the influences of social, topical and technical factors on network use.

Social Influences on Teachers' Use

The character of the Science Teachers' Network as a community was as a large group of people who were not familiar with many others, but who knew that the membership consisted of persons with varying expertise. The teachers were aware that people on the network had various roles: they knew that most were practicing science teachers or administrators, that some other members were designated to have either special expertise or a coordinating role, such as the special guests and participating scientists, or the project staff. On the "Who Is" list were names of persons from various prestigious institutions, such as the Harvard Astrophysical Observatory, or the New York School of the Future, and the names of four school district superintendents. When a new member looked over the complete "Who Is" list, he or she would find many names and their affiliated schools or institutions, but would know nothing more about the person. In mid-April this list contained 110 names.

More information about some of the members was present in the Biography Forum, where members were asked to write something about their interests and experience. Thirty-seven teachers, two special guests and two central staff listed their interests in that forum. Other than through the "Who Is" list and the biographies, a member's awareness of other members could develop from attending one of the training meetings (3/4 attended a training meeting), and from reading the exchanges on the network. But since the average rate at which members wrote messages was about once a week, a long period of network use would be necessary for members to get to know other members through their messages alone.

Thus the community was experientially rather vague in size and nature; a member could get a feeling for what people were like only after a period of use and regular logging in. From our weekly observations of the network, and from some teachers' comments in the final interview, we infer that this type of community may have intimidated some users. There was no direct interview question on this topic because it was not a topic best approached directly. But teachers commented about it in response to more indirect questioning. One teacher described his feeling when writing messages as similar to the "mike fright" experienced by ham radio operators as they begin to send their first messages. He found that not knowing who was listening was quite unnerving when he began as a young radio operator, and he believed that beginning conversations on the network entails the same quality of uneasiness for many people. Another network member, although he was an experienced computer user and one of the few members with technical knowledge of telecommunications, said, "you're always worried that your messages will seem ignorant or you will misspell something."

Several teachers spontaneous mentioned needing more *time* to get involved, without specifying why the time would help (alas, we did not probe on this point!). One stated, "I was just getting started when the year ended." Another said: I really enjoyed it [even though] this year we just got our feet wet." A third said "...I think it takes about a year to get started and feel comfortable."

These statements suggest a shyness effect consistent with the picture emerging from the forum analyses and from observations of the initial use of private mail. All of these suggest that the new medium may cause a certain amount of discomfort, which might be exacerbated by lack of acquaintanceship with members. This hypothesis is supported by a positive correlation between number of previous acquaintances and writing:reading ratio, and between rate of public writing and attendance at the January meeting (Table 4). Furthermore, those who had taught longer wrote more; they knew more members ($r=.35$, $n=33$, $p<.05$) and may also have had more confidence in such a group.

While the network may have been intimidating, as a group, or as a medium, what is very hopeful is evidence on two important points: (1) lack of interpersonal familiarity was *not* insurmountable in the conference, and (2) the network reached and especially appealed to, the population it most wanted to reach -- teachers who were more professionally isolated.

On the first point, when asked, "do you feel that you really got to know anyone by interacting with them on the network or by just reading their messages?", 36% answered yes, and these members tended to engage in more writing relative to reading ($rho=.28$, $n=36$, $p<.10$). They mentionned the names of members who had written many public messages, or with whom they had exchanged information on a particular topic. Whether their writing helped them to know others, or whether they were sociable types who were inclined to write alot and report "getting to know" others, is unclear.

Table 4

Correlation Between Social and Professional Characteristics of Teachers and Network Participation

(Spearman rho/n)

Social and Professional Characteristics	Participation					
	Rates				Ratios	
	Logging In	Reading	All Writing	Public Writing	Writing/ Reading	Public Writing/ All Writing
Mention keeping up on science or science teaching as a difficulty of the profession	-	-	-	-	-	-
Mention lack of colleagues as difficulty of the profession	-	-	-	-	-	.25 (42)
Frequency of informal contacts with colleagues outside of own school	-.30 ** (35)	-.39** (38)	-	-	-	-.38* (23)
Frequency of formal contacts with colleagues outside of own school	-	-	-	-	-	-
Number of other STN members previous known by name or better	-	-	-	-	.32* (34)	-
Attended December meeting	-	-	-	-	-	-
Attended January meeting	-	.24* (48)	-	.39*** (48)	-	-
Years in teaching	-	-	.26* (44)	-	-	-

*p ≤ .10 ** p ≤ .05 *** p ≤ .01

Furthermore, in contrast with Crook's (1985) concern, we did not find that the channel of information was limited to pre-existing relationships. Analysis of who knew who previously, and who wrote to whom in private mail, shows that the majority of teachers wrote more or less equally to known and unknown individuals. Fifteen teachers wrote more to persons who were completely unknown to them; 10 wrote to more persons who were known, and 4 wrote to as many known as unknown persons. This finding is consistent with the analysis of the social functions of messages in which one of the most common social functions was responding. In the network, as noted above, messages were often addressed to both an individual and a forum, which was a useful way to make interactions both personal and public. Many of the messages written to unknown persons were probably answers to questions posed earlier by the person. Thus while acquaintanceship increased writing on the network, interactions could begin without previous acquaintanceship. The conference appears to have encouraged interaction, and we must infer that teachers' interest in the topic of a question outweighed any social uncertainty that they may have experienced.

On the second point, three correlations are indicative: Teachers with fewer informal contacts with colleagues outside of school logged in and read more, and did relatively more public writing. In addition, their view that lack of colleagues was a difficulty of the profession was also positively correlated with public writing.

It is interesting to note also that spontaneous mention of difficulty keeping up on science or science teaching was not correlated with use. So ironically, although teachers used the network to exchange information, and stated that information was a valued resource to them in their final evaluations of the network, active users were not necessarily those who felt a lack of information.

Although the correlations are few and scattered, the number is greater than expected by chance, and they yield an interpretable pattern. The pattern suggests that the network was given passive use -- logging in and reading -- by teachers who had fewer out-of-school contacts and sensed a lack of colleagues, but that active use -- writing -- was increased by knowing other members.

Finally, we pursued one further analysis to test whether there was any evidence that "shyness" was reduced over the course of members' participation. We hypothesized that, if initial shyness was the major cause of less writing and less public writing at first, and network participation could diminish it, then public writing should increase with time, and perhaps the ratio of writing to reading would also increase. We examined the pattern of use over time among continuing users, looking at log-ins, public writing, and the writing to reading ratio, and found that no such pattern emerged. The only pattern emerging was one of initial interest, followed in some cases by a dropping off of participation. Thus the shyness hypothesis which emerges when comparing forums and looking at forum development over time, and across individuals in the correlation of previous acquaintanceship with writing (relative to reading), does not hold up looking at continuing users over the course of their participation. This means that, among the continuing users we studied, either shyness was not reduced, or shyness was not a predictor of public writing. This evidence, and the finding above that members wrote to unknown persons as well as known ones, suggest that in this conference members' interests were also a very important factor in determining their participation.

Technical/logistical Influences on Teachers' Use

Table 5 shows the relation of access factors to rates and patterns of participation. Access to network use can be seen in terms of cost barriers, convenience barriers, and barriers deriving from the degree of previous experience with and knowledge of the technology. These factors could affect network participation in a complex way. For example, having the computer at home might be most convenient, but costs may be incurred. Costs would be decreased by using uploading and downloading.

Having the computer at home, needing no hookup, and without cost burden (Row 2), was correlated with increased participation rates of all types. Having the computer at home was also associated with more public writing. Of those whose computer was at school, there was no relation to participation of whether it was more nearby, or available more of the time, or without needing hookup.

As would be expected, teacher's own report that costs or time problems decreased participation was associated with lower rates and less public writing. Even though these responses could be interpreted as the member's ready excuse in the embarrassing situation of being interviewed by the eager network organizers, it is probably true that costs and time were significant barriers to participation for some members.

Oddly, previous modem experience was weakly associated with lower participation rates. It should be noted that this correlation might have been reversed if the teacher moderators were included in the sample. Three of the four teacher moderators had previous modem experience and were very active users. The teachers who had previous modem experience taught the same range of subject matter that others did, so the correlation cannot be explained as due to subject matter interests. Apparently (with the exception of teacher moderators who were not included in this sample), the network appealed a little more to teachers who were inexperienced in telecommunications. Again surprisingly, reporting of uploading or downloading to the network was not correlated with actual use. But again, this sample did not include the teacher moderators who made extensive use of uploading and downloading.

Influences on Forum Development

Subject Matter Forums: the Roles of Moderators and Guests

The four teachers who moderated subject matter forums (Chemistry, Biology, Physics and Earth Science) were all very active users, having very high rates of logging in, reading and writing. When these forums began, it was not clear to ETC staff or the moderators exactly what

Table 5

Correlation Between Teachers' Access and Network Participation

(Spearman rho/n)

	Participation					
	Rates				Ratios	
Access	Logging In	Reading	All Writing	Public Writing	Writing/ Reading	Public Writing/ All Writing
Location of computer (0=both/1=home/2=school)	–	–	–	-.35 (38)	–	-.38** (33)
Computer at home, no costs, no hookup (0=no/1=yes)	.27* (38)	.28* (38)	.40** (33)	.31* (38)	–	–
Computer at school and in an inconvenient room	–	–	–	–	–	–
Computer at school and not always available	–	–	–	–	–	–
Computer at school and needs hooking up	–	–	–	–	–	–
Reports problems in costs using STN	-.55** (47)	-.55** (47)	-.53** (47)	-.61** (47)	-.27	-.50** (47)
Reports problems in time available to use STN	-.35* (47)	-.32* (47)	-.33* (47)	-.27* (47)	–	–
Reports previous modem experience	-.27* (48)	-.31* (48)	–	-.25* (48)	–	–
Reports uploading to STN	–	–	–	–	–	–
Reports downloading from STN	–	–	–	–	–	–

*p ≤ .10 **p ≤ .05 ***p ≤ .01

moderators should do to best encourage participation and involvement of members. Their actions evolved from their own styles and from discussions over the network and in two meetings with ETC staff.

In all cases, they were the most dominant writers in their forum; the number of messages written by a forum's moderator was exceeded only by those written by special guests. Their messages usually focused first on subject matter and teaching issues, but also included social facilitation. All wrote messages in private mail to new teachers, brought attention to unanswered questions or related messages in the forum, and acknowledged or thanked members for a question or other contribution. In addition, two members also used a style including explicit social appeals. One moderator made very substantial contributions to the subject matter content of the forum by regularly posting reviews of articles, making comments on items in the news, and in other ways. Even though the moderators were also busy teachers themselves, they devoted a great deal of time and effort to their forums.

An example of a moderator's message, illustrating the combining of subject matter and social focus is as follows:

> John, Thanks so much for your terrific analysis of your current textbook. Sounds as if you had to fight for a long time for your text, but seems to be worth the fight. I particularly like your information on the questions at the end of the chapter. Many times these questions are just used as rote memory type questions for the student to throw back what they just read in the chapter. Your book makes a good attempt to have the students think about the material and bring many strands together to answer questions.
>
> What about the rest of you....teachers? Let's hear from...

Although the moderators differed somewhat in style, there seems to be no relation between these styles and forum participation. Forum use, both reading and writing, is attributable to the number of teachers on the network teaching the subject matter, and perhaps also to member's styles as information consumers -- omnivorous vs. selective. For example, the earth science area benefited not only from a forum whose moderator who gave extended efforts in providing both social and substantive facilitation, but also from a special guest on that topic. Yet the number of persons who wrote to or read most of the Earth Science and PBS Earth forums was low. The avid readers included several who taught earth sciences, and some others who tended to be omnivorous readers. Looking at use of all four subject matter forums, their popularity in terms of both writing and reading is in the same order as the number of network teachers teaching that subject.

Similarly, the presence of guests seems to increase participation but not beyond limits imposed by subject matter interests. James

Kaufman, a consultant on lab safety, was asked to address his comments to the relevant forums rather than in a separate forum. He became a major participant in the Chemistry Forum, and the total activity of the forum was no doubt increased because of his presence. Yet the earth science area received just as much input through the Earth Science moderator and two guests -- Victor Schmidt, a developer of the Planet Earth series on PBS, and Ralph Lutts, specialist in environmental education. The lower participation in those forums cannot be attributed to lack of guest input, but to the small number of teachers who were interested in earth science.

Value of the Network to Teachers

Although only a quarter of the teacher members used the network once a week or more often, two thirds (20/31) were entirely positive in their evaluation of it and only 3/31 said that the network had not served their interests. The two most frequent themes in response to the question of how the network "had served or not served your interests" were providing opportunity to communicate with colleagues, and obtaining specific information. Half (16/31) offered the first theme, their elaborations including, "I am the only Chemistry teacher in my school"; "I am the AP Physics [teacher] at my school -- not many meetings to attend; "a method to contact other teachers...a very diverse group I couldn't [otherwise] come in contact with"; "I felt I had broken out"; "...get beyond your own system...good to see how things are with other teachers". An equal portion (14/31) cited opportunity to obtain information, of which nine mentionned obtaining specific information such as conference announcements, five mentioned opportunity to solve problems and to ask questions ("got good answers") and one used the term "background information".

The three members who said that the network did not address their interests in any way offered a range of comments. One said "I did not find a need for what I conceived the purpose of the network to be", going on to say that he had three colleagues who taught the same subject and that his school system provided both time and funding for him to attend conferences. He also said that "In terms of when I did use it...(responding and asking questions) I found it a problem in that it was not a true conversation." Another teacher who had negative comments said, "Initially I expected computer programs and materials". He went on to say that the school year came to an end about the time he was ready to use the network in other ways. The third teacher said, "I didn't see the information that was useful to me in forums...I thought I'd get more curriculum stuff -- how to use the computer in the science room." The negative comments of those who also offered some positive comments included: not receiving answers to questions and feeling disappointed; that there was a lack of "real discussion" and it was "not as expert" as one would like; that it was "very cumbersome to go through many messages...just so many messages"; that it was hard to use because of problems with access and phone costs; and that there was no "in depth background".

The value of the network to teachers was also gauged by their answers to the question, "Did you get any teaching ideas, new science information, or an update on materials through the network?" Teachers were asked this regardless of the number of their log-ins (n=41). More than two-thirds (30) said yes and were able to give a specific example of general description of what they had gained. Reporting this gain was correlated with number of logins; all reporting no gains or unclear outcomes had few logins (<7); and only 7/30 of the gainers had few logins.

The number of these ideas ranged from "a few ideas" to one member's statement that there was "very little that wasn't useful, that's what I appreciate". Among the specifics gained, one teacher said that he had attended a conference he would not have know about; several members listed a particular chemistry demonstration which they now do differently or have added to their repertoire; or other specific items like fume hood, or test question banks. Some "new information" resulted in changes in curriculum. One teacher had added NOVA programs and held class discussions; another added material presented in the PBSEARTH forum in class and did a lesson on paleontology which he had not planned. A third said humorously that a "what-to-do-in-the- class-before-vacation" idea had "saved his life".

The teachers who phrased their gains in more general terms mentionned several topics: one chemistry teachers said "I broadened by own oideas and [the] background which would effect my teaching." Several said that they gained information about lab safety and revised some activities. Several said that they had revised or were revising chemical storage practices. Another participant said he learned how to get additional information, such as where to get lesson plans. Another's comment implied perceived reduction in isolation: "...also, I, and colleagues, noticed things others were doing that we didn't know about."

When teachers were asked what they saw as the best uses of this network for science teachers, some echoed earlier comments about valuing the opportunity "communicating with each other" and "sharing ideas". One member said, "Just to communicate with each other is wonderful. It made me feel part of a larger community. It was the first time I had access to my colleagues."

More specific uses included: "ways to get information you can't get any other way"; keeping "current on topics that seem most important to teachers today, like safety"; "being able to trade secrets...some of the unwritten things" about texts, labs and software that people have used and adopted. These responses contained two main themes: providing opportunity for communication with other science teachers who share the same interests and problems; and exchanging ideas and information about teaching materials and stragegies as a way of getting "new ideas." One member summed up ideas presented by many others when he said, "...provide contact between teachers that may be looking for psychological support, educational support, new ideas, and simply [to] communicate with other people that have similar interests."

None of the teachers said that there was no place for computer-based conferencing. Teachers who had not found that the network served their interests suggested uses of the network for others. For example, the teacher who had colleagues at hand said, "Conceptually, I like the model. It sits well with me. I didn't use it and I'm hoping that's just a function of my needs". The elementary school teacher who did not see the information in forums as useful said that a use of the network was "being able to share curriculum ideas but the cost is too high. Schools should pay the cost of calls." The participant who had concern about lack of "real discussion" and lack of expertize listed two uses for the network: "keeping in touch" and "questions".

While the enthusiasm of the teachers may be partly explained by their wish to please the interviewers who they knew to be the network staff, certainly some of their enthusiasm was genuine.

CONCLUSIONS AND RECOMMENDATIONS

We address here, in order, the three goals stated earlier concerning the success of the network in promoting collegial exchange, the influences on use of the conference, and recommendations for this and other possible applications of computer-based conferencing for teachers, in so far as these can be drawn from the study.

How well did the network succeed in promoting collegial exchange about science and science teaching? Let us break this question into its three components, (a) level of network use; (b) "exchange"; and (c) science and science teaching content. Concerning the first two aspects, the network provided a channel for communication that could increase their professional contact over and above what they could gain from face-to-face contacts. About a quarter used it often and engaged in exchange of information on discrete points or in discussions of more general issues, some with notable affect and expression of personal views. Even those who participated only occasionally did engage in "exchanges", in that the predominant social acts were seeking/offering and responding. Many of those who used it infrequently still felt that the network had served their interests, and expressed enthusiasm about it. From their comments, we infer that these teachers valued the network as a resource opportunity, even if they did not choose to use it often.

The staff goal, however, was for more frequent use, and more "discussion", by a larger portion of the membership. The network fell short of meeting these particular criteria of success. However, findings from Kerr & Hiltz' (1982) meta-analysis of mainframe conferencing research suggest that the staff may have set unrealistically high goals: (1) the Science Teachers' Network users fit their characterization of new and inexperienced users; (2) Kerr and Hiltz state that some inequality of participation is to be expected. In this perspective, the seeming reticence of some teachers and their variable participation is due to the fact that many teachers never gained enough conferencing experience, regardless of the cause, to move into more interpersonal engagement.

In message content, the network met well the goal of focus on science teaching, less so in terms of science itself, and little in terms of new developments in science. The latter topics may require input from outside science experts; in this implementation, in response to teachers' expressed interests, the guests were (with one exception) persons addressing practical aspects of science education, rather than of science itself. We did not attempt to make the conference more didactic in purpose or to mold it toward topics apparently not of critical interest to the teachers. Because topic seems so critical to gaining participation among unacquainted persons, we would guess that it would be difficult to move a conference in a direction not of immediate concern to the participants, but that it could perhaps be done if a sense of group involvement and concern were successfully created as a first phase.

Concerning the second research goal -- understanding influences on use of the conference -- the study leads us to comment on some characteristics of the medium that seem related to three kinds of influences: technical, social, and topical. The ways in which these factors are interrelated imply guidelines for teacher network applications and management.

A characteristic of asynchronous computer-based conferencing is that the host computer serves as a repository for messages which are sent and read at the convenience of participants. The time lapse between the entry of a message and its being read and responded to is unpredictable to the sender, and varies among a message's readers. A communication system without databases, like Common Ground, cannot be used for information needed immediately because one cannot predict the likelihood or time that an answer would be available. At the same time, if participation is a goal, topics must be chosen that will interest the members enough for them to log in. The topics must be interesting but not urgent. The importance of topic was most clear in the use of subject matter forums in the Science Teachers' Network, in that both reading and writing were more strongly related to the member's teaching area than to input by moderators or guests. In this case, the topic seemed to set the final constraints on participation. We have argued that, among unacquainted members who have not yet developed a sense of social obligation to respond, the appeal of the topic is more critical than among acquainted members. If the purposes of a network are more explicitly social and personal, and if members are more acquainted, perhaps topic would not be as critical. Also, an entirely different profile of use would presumably emerge in a network which required participation through incentives other than just interest, or better, through carrying out collaborative activities on the network that could not be accomplished otherwise.

A paradox of the medium seems to be that, while interactions in the conference are public and equally accessible to participants because the medium is not spatially limited, interactions are broken down temporally. Some topics and applications may be more amenable to temporal fragmentation than others. In a conference designed for interaction (in contrast to a tutorial purpose or dissemination purpose), it seems that interactions would derive best from messages that contain a well defined point, but also invite a response. We have not attempted to do an analysis of the topics or kinds of discussion best suited to the medium from our one case, but others who are able to compare more cases have offered some comments on this (Kerr & Hiltz, 1982).

Another feature of the medium is that the audience is unseen. If members vary in their reading habits, the membership list is only the potential audience for a message and the user does not know exactly who will read a given message. In the Science Teachers' Network, we found that some members were posting printouts for others to read, so the audience was not confined to the membership list. We found no signs that the medium disinhibited teachers. On the contrary, the comments of some members, the high ratio of read acts to write acts, the initial lack of personalization of messages and reliance on simple questions of information, suggest that members felt some reticence and uncertainty. Reticence was present in spite of moderators' efforts to welcome members and to encourage participation. Ofcourse it is not clear how much of this reticence is attributable to the medium, to the inexperience of users, or to the nature of the group. Perhaps this reticence would occur among unacquainted teachers is they were meeting face-to-face as well. On the other hand, these results also suggest something like the "fishbowl" effect reported to bother computer conference users (Kerr & Hiltz, 1982) in which users have the feeling of being monitered or watched and that "stupid" errors are obvious to all. Or perhaps the lack of nonverbal feedback of the medium caused teachers discomfort (Kiesler et al., 1984). As noted above, this kind of discomfort is seen as characteristic of inexperienced users by Kerr and Hiltz.

Topic may play a more critical role in beginning interactions in computer communications than in face-to-face communications. In a face-to-face gathering of unacquainted persons, a friend's introduction, or sheer spatial proximity, may allow an interaction to begin. In computer-based conferencing spatial proximity is irrelevant. The content of the message may then play a larger role in determining whether an interaction will begin. Kerr & Hiltz have listed reliance on message content as a characteristic of new users in particular, relating it to their lack in knowing how to communicate when visual cues are absent. They state:

> Unless supplementary forms of communication are used...most of the nonverbal content is lost, for better or for worse. On the positive side is the consideration that it is the content of the communication that can be focused on, without any irrelevant status cues distorting the reception of the information... (page 20).

Topical constraint on social interaction is more or less a counterpart to Crook's fear of social constraints -- that information might be channeled along lines of pre-existing acquaintanceships. Crook's concern was that people would have answers to others' questions but would not feel obligated to offer them without social bonds, such that information would tend to follow channels of pre-existing relationships. The Science Teachers' Network data suggest, rather, that where social bonds are absent, information might as easily tend to follow channels of topical interests. However, neither of these occurred in the extreme: we found some "omnivorous" readers, if not writers; we also found that members addressed messages to people they did not know previously as often as to people they knew.

Technical (and logistical) factors appear to present a final constraint, a ceiling, on use at two points -- the host machine, and the end user. At the location of the host machine, the total activity of the network which might be a function of an interaction of social and topical factors, is limited finally by the capacity of the single phone line. For the user, regardless of social and topical motivating factors, log-in frequency is limited by access to equipment and costs, and ability to use equipment. An interaction of technical and topical factors occurs around uploading and downloading. Uploading and downloading will reduce phone costs and also change the nature of responding -- allowing the user to read and reread messages more easily and to "digest" ideas before responding. The greatest technical barrier to users in the Science Teachers' Network was the initial setup of communications software. The variety of combinations of communications software and modems limited our ability to help users with their problems or to train them in uploading and downloading.

From the above we would offer recommendations in four areas for networks aiming to promote information-sharing and discussion among unacquainted teachers: hardware and software; applications (membership policy, topical focus, and network management); changes in Common Ground; and user training.

Strongly recommended is use of the same hardware and communications software, so that inexperienced users can learn quickly how to upload and download and can attend to the content rather than the mechanics of reading and writing. Having a computer at home and without cost seems to allow teachers the best access.

In choosing a topic for the conference, the application should be tailored to anticipated log-in frequency. There is no point in choosing a topic for which information is needed rapidly unless frequent log-ins are a certainty. At one extreme there is the possibility of a conference which functions more or less like a professional journal which one peruses in one's spare time, but with the added capacity for interaction. At the other extreme would be a conference oriented to an activity which could not be accomplished without using the conference. This kind of activity would exert the maximum pressure to log in because the activity could not take place otherwise.

This activity approach is the one being recommended for educational applications by researchers at Bank Street College (Newman, 1985) and the University of California - San Diego (Vaughn, 1985; Riel, 1986). In a meeting on the topic, "how can networks help accomplish educational goals?" at UCSD, researchers noted that "the successful use of networks depends on the design of a functional 'learning' environment." Similarly, Riel (1986) notes that network activities for teachers should be designed to fulfill the educational goals of teachers, not simply to allow a channel of communication. The functional learning environment is defined as one in which knowledge is acquired through engagement in tasks that are meaningful to both learner and teacher (Newman, 1985). Translating this concept to the use of computer-based conferencing for staff development would dictate defining conferencing activities that were meaningful to teachers in their practice and would engage them in probing specific issues. This application would differ from the Science Teachers' Network which was flexible enough to include both active users and "browsers".

In planning future conferences, the criteria for selection of members and for membership size would seem to derive directly from the purposes and topical focus of the conference. If an activity will be pursued, there may be an optimum group size, which could be estimated from prior research on small group process (face-to-face). For interactions to develop among unacquainted persons, it seems best to maximize the degree of common interest in the group by either limiting the topical focus or introducing collaborative activities, as noted above. If it is important for group solidarity to develop, then peripheral members, such as persons who observe but do not participate, should not be admitted. In this respect a computer-based conference may need to follow the usual rules of small group interaction. On the other hand, if information-sharing is the goal, then a large membership may be required, especially considering that voluntary membership seems to involve variability in log in frequency.

What members will talk about, and who will decide, would be central defining features of a conference. The problem of defining forum topics is similar to that of defining conference topics: both have issues of authority, and of clear definition and presentation. How topics originate and are described to others, and the meanings that topics have -- their latent ambituigies, boundaries, possible directions -- all seem relevant. Similarly, within a forum, a moderators' or guests' duties and roles depend on topic and purpose, ranging from didactic to facilitative. To encourage discussion, in the sense of extended exchanges on a topic with some degree of personal engagement of participants, would seem first to require a topic that is general enough to allow all members to have something to say, and also to require social facilitation. If a goal is to provide new information, then experts (guest or member experts, or members who have the role of searching out information) are required. In this case the role structure is completely different and other participation structures would be expected.

Finally, for discussion to occur, we would repeat the advice we learned and followed before the project began: for managers to provide opportunities for face-to-face interactions when possible and for moderators to provide social facilitation on line in the form of introductions, pointing out common interests, and in other ways.

We are recommending several changes in Common Ground that would make the system more adaptable to variable log-in frequency and to encouragement of user participation.

Common Ground (and other systems with similar features) works best if the log-in frequency does not vary widely among participants, and if members log in frequently enough not to be overloaded by a backlog of messages. The appropriate frequency would depend on writing activity. If the application is such that members would log in with varying frequency, there must be a way for the infrequent users to read less than all of their new messages. For an information-oriented conference, selection of messages by topic lines would be useful. This feature is already available in Common Ground. Yet, as Duranti (1986) has also pointed out in a sociolinguistic study of topic lines, topic lines do not necessarily describe the complete content of messages. This is because the topic line is entered before the message is composed. The content of the message may only develop during the process of writing, so the original topic line may be inaccurate. To allow the reader to revise topic lines so that they more accurately reflect the content of the message, topics lines could be composed after the message, or an option to revise the topic line could be presented to the user after the message is completed.

For an information-oriented network, an alternative way to reduce the volume of reading, similar to topic line selection in that it subdivides the topical content and then allows the reader to select subtopics only, is that separate forums be initiated on subtopics. The reader would then need only to visit certain forums. In this case, the decisions made by moderators and system operators become crucial since they have the technical means to establish forums.

On the other hand, in a discussion-oriented conference leaning more on developments over sequences of social interactions, it may be inappropriate for readers to select by topic lines. Rather, they might read only the messages after a certain date. This would require no changes in Common Ground, but suggestions would be made through user training.

A second change in Common Ground which might encourage more message writing is to add a prompt line after display of a message that asks the reader whether he/she wants to respond. This feature would be useful only for users who read from the screen, and read small numbers of messages at one session.

Thirdly, we recommend the option of a means to describe forum purpose, either a "banner" or a special message. At present the only banner available appears when the user enters Common Ground. Additional banners or special messages for each forum could be used by moderators to bring readers' attention to unanswered questions, or to summarize the history and present status of a discussion.

Our suggestions for user training have arisen in connection with earlier points. Learning to upload and download may encourage "digestion" of message content if long messages are used; training users in to compose topic lines that describe the content of the message, and how to select messages by topic, date or author, will reduce the problem of message overload if user participation will vary.

The recommendations made here derive from an view that the medium itself, while it may have certain characteristics, will allow a variety of kinds of interactions to occur. The main challenges of a network seem to be human ones of defining a purpose and structure for interactions. The next year's research efforts are designed to examine several natural experiments that will help sort out the interrelation of social, topical and technical influences and allow drawing firmer guidelines for future educational applications of conferencing.

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APPENDIX A

Hancock, C. (1985, Dec.) Common Ground. Byte, pp. 239-246.

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COMMON GROUND

BY CHRIS HANCOCK

The user-friendliness of this microcomputer-based conferencing system derives from its easy-to-visualize functions

IN THE COURSE of putting together a computer-based conference for science teachers, my colleagues and I wound up writing a complete conferencing system that runs on a microcomputer. It's called Common Ground, and we think it's the best in its class. In this article I'll talk about the program and some of the thinking that went into its design, and I'll present some of the program's internal structures. I'll also discuss some issues to consider in running your own conference using Common Ground.

The Educational Technology Center is an organization funded by the National Institute of Education and based at the Harvard Graduate School of Education. Its mission is to study how computers and other new technologies might help improve the teaching of math, science, and computing. One problem we've been looking at is the isolation of science teachers: Many science teachers, especially in rural areas, have very limited opportunities to share ideas with colleagues or to find out what's new and interesting in their scientific fields. Computer conferencing seems to be one promising way to address the problem. We've been putting together an experimental computer-based conference for science teachers in order to see the ways it might help.

We needed our conferencing software to satisfy several requirements. First, it had to be easy to understand and use; this was our single most important criterion. At the same time, it needed to be a real conferencing system with enrolled participants, full capabilities for private messages, flexible organization of public discussions, and effective ways of searching through messages to find what you're looking for. Finally, we wanted a system that would run on a microcomputer.

School districts, like many other organizations, have modest budgets, and for most of them a large computer is out of reach. Of course, there are limitations to using a microcomputer. For the time being, at least, most micros can support only one user at a time. This imposes a pretty hard limit on the total number of participants, but the limit is not as low as one might think, provided people's schedules are varied enough. We have seen a conference with as many as 100 regular participants run comfortably on a micro. Given that one of our goals is to develop a strong conference community, more than 100 people would probably be undesirable anyway. The one-user-at-a-time limit also means that occasionally you do get a busy signal when you call, and you have to try again later. This wouldn't do for businesses where messages need to get through quickly and without fail, but for our application that isn't so crucial.

AN EASY SYSTEM TO USE

We couldn't find the system we wanted, so I wrote it. We feel that its simplicity and ease of use are a design triumph. The single most important reason for this is the spatial metaphor around which the system is structured. We picture the Common Ground system as a building with rooms in it. Every enrolled participant has a private office that no one else can get into. Private mail sent to a par-

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ticipant is delivered to that person's office. The building also has other rooms, called forums, that anyone can visit. Each forum is devoted to a particular discussion topic.

The power of the spatial metaphor is that it makes it easy to understand the state of the program ("where" you are in it) at any moment. Most interactive programs can change their states in a couple of ways: The data that is active or loaded may change (for example, you might load a new text file into a word-processor buffer) or the current mode may change (for example, in a database program you might go from record-definition mode to data-entry mode). In the Common Ground system, the idea of moving from room to room stands for a change of active data. When you are in your office, you have access to your personal mail; if you move to a public forum, you have access to the public mail there. As for modes, I have consciously worked to keep the number to a minimum. In fact, for the ordinary user there are just three modes. The main mode has just 10 commands. Then there's message-entry mode, where you type in your messages. The third mode is the text editor, which can be avoided by novices. (There are also special modes for the operator and other privileged users.) The main-mode commands are as follows:

scan: lists the messages in the current room.
read: reads messages in the current room. The scan and read commands both accept qualifiers that select messages in the room, based on date, author, topic, and whether you've read them before.
send: sends a message to any room or combination of rooms. The send command features a line editor for those who want to edit their messages before sending them.
scout: lists all forums on the system and the number of new (for you) messages in each one.
visit: lets you move from room to room.
home: takes you back to your own office.
whois: provides information about a participant or a forum.
set: lets you change your password as well as specify the width and height of your screen.
help: provides full on-line documentation.
bye: ends the session.

The short sample session shown in figure 1 gives the flavor of the system. As you can see, private and public mail is read and sent in pretty much the same way, using the read, scan, and send commands. Their effect simply depends on what room you're in and what room(s) you send messages to. This is a good example of the design principle known as orthogonality: One set of features operates independently from another set, with every possible combination having a meaning.

Orthogonality is prized by software people because it generally lets you express a lot in terms of just a few basic concepts. Sometimes, though, an orthogonal structure forces you to abandon your commonsense understanding of the application in favor of a more abstract one. This trade-off came up in the issue of groups and forums. Besides participants and forums, there is one other kind of entity to which you can address a message: a group. Groups do not correspond to rooms in the system. Instead, each group has a membership list, and any message sent to that group is distributed to the offices of all members of the group. Membership in groups is controlled; you have to ask to be enrolled in them. Groups are intended for topics that are confidential or urgent.

So groups and forums differ in two ways: Groups have restricted access, while forums have open access; and group messages are delivered to their members, while forum messages go to a room of their own. Thinking orthogonally, it's possible to imagine two other kinds of entities: forums with limited access, so that not everyone can visit them; and groups with free access, which participants can enroll in at will (perhaps using commands like subscribe and cancel, to invoke the home-delivery feature).

This time, we decided the orthogonality wasn't worth it. For one thing, it makes the solution more complicated than the problem. For almost any conceivable purpose, one of the existing options (forum or group) will do just fine. Moreover, a lot of attention devoted to access and privacy schemes would be out of place in a system intended to promote a feeling of community. The other important consideration was simplicity. Forums and groups are easy to understand: The words "forum" and "group" resonate well with the way they actually work on the system. Abstracting out the two dimensions they differ on would lose us that valuable intuitive base, unless we devoted a lot of effort and emphasis to a more extended metaphor (perhaps involving keys or secret passwords to forum rooms, which begins to seem more like an adventure game!).

DESIGN ISSUES

The most important work in producing a piece of software like Common Ground is not implementing it but specifying it—designing the way it will appear to users. Furthermore, in order to decide how the program should behave, you need, in effect, to design all the activities that will take place around the program. It is vital to recognize that the software system functions as a part of a larger system of human and technical interactions. As the principle of top-down design implies, the first task is to design that larger system and then to proceed down to the computer program itself. Design decisions at the top level will have implications for the design of the actual program.

In principle, this is true for any program. It is crucial in the case of a computer conferencing program for two reasons. First, computer conferencing consists of more than just the running of a computer program. Second, because computer conferencing is in its infancy, there are plenty of open questions concerning how a conference should be run. These are also the reasons why our eventual goal is to produce a package that includes, in addition to software, an extensive guide to running an educational (or other) computer-based conference.

We began our top-level design work by looking at the different kinds of problems that computer conferences can run into and thinking about ways to solve them. One of our conclusions was that a successful computer conference must have people working in several different roles, which are described in the following sections. The existence of these roles has in turn affected how the software is designed. Naturally, the importance of these roles varies with the type of conference. In a very informal conference,

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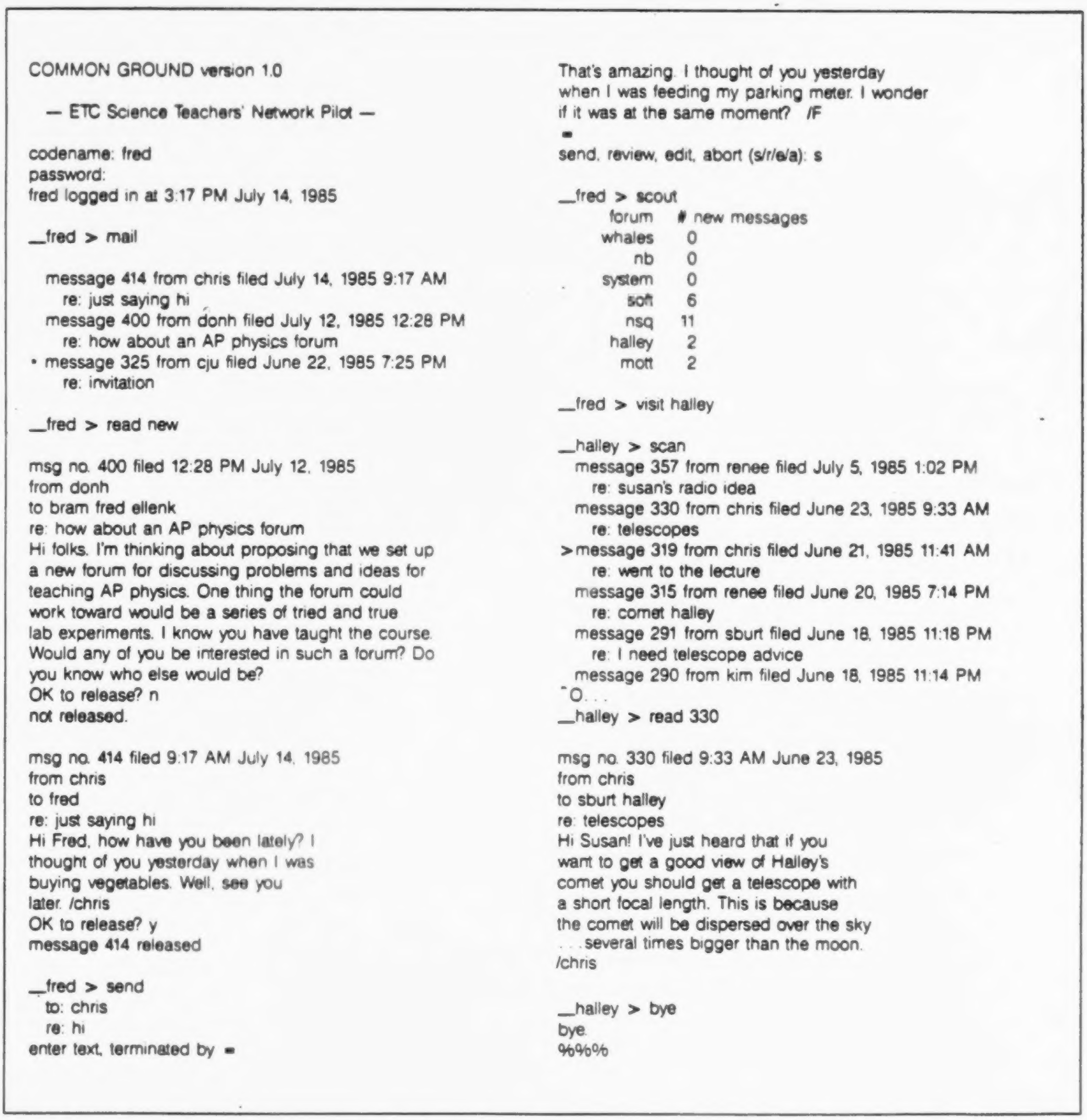

```
COMMON GROUND version 1.0

  — ETC Science Teachers' Network Pilot —

codename: fred
password:
fred logged in at 3:17 PM July 14, 1985

__fred > mail

  message 414 from chris filed July 14, 1985 9:17 AM
    re: just saying hi
  message 400 from donh filed July 12, 1985 12:28 PM
    re: how about an AP physics forum
• message 325 from cju filed June 22, 1985 7:25 PM
    re: invitation

__fred > read new

msg no. 400 filed 12:28 PM July 12, 1985
from donh
to bram fred ellenk
re: how about an AP physics forum
Hi folks. I'm thinking about proposing that we set up
a new forum for discussing problems and ideas for
teaching AP physics. One thing the forum could
work toward would be a series of tried and true
lab experiments. I know you have taught the course.
Would any of you be interested in such a forum? Do
you know who else would be?
OK to release? n
not released.

msg no. 414 filed 9:17 AM July 14, 1985
from chris
to fred
re: just saying hi
Hi Fred, how have you been lately? I
thought of you yesterday when I was
buying vegetables. Well, see you
later. /chris
OK to release? y
message 414 released

__fred > send
  to: chris
  re: hi
enter text, terminated by ■
That's amazing. I thought of you yesterday
when I was feeding my parking meter. I wonder
if it was at the same moment?  /F
■
send, review, edit, abort (s/r/e/a): s

__fred > scout
      forum   # new messages
     whales     0
         nb     0
     system     0
       soft     6
        nsq    11
     halley     2
       mott     2

__fred > visit halley

__halley > scan
  message 357 from renee filed July 5, 1985 1:02 PM
    re: susan's radio idea
  message 330 from chris filed June 23, 1985 9:33 AM
    re: telescopes
>message 319 from chris filed June 21, 1985 11:41 AM
    re: went to the lecture
  message 315 from renee filed June 20, 1985 7:14 PM
    re: comet halley
  message 291 from sburt filed June 18, 1985 11:18 PM
    re: I need telescope advice
  message 290 from kim filed June 18, 1985 11:14 PM
^O...
__halley > read 330

msg no. 330 filed 9:33 AM June 23, 1985
from chris
to sburt halley
re: telescopes
Hi Susan! I've just heard that if you
want to get a good view of Halley's
comet you should get a telescope with
a short focal length. This is because
the comet will be dispersed over the sky
...several times bigger than the moon.
/chris

__halley > bye
bye.
%%%
```

Figure 1: *A sample session on Common Ground. The user reads three private mail messages, sends a private mail message, checks for any new activity in the forums, visits the* halley *forum, and reads a message there.*

Many would-be participants never get over the initial hump of learning to use a conferencing system.

with computer-literate participants, all the jobs can easily be done by one person.

USERS' TECHNICAL PROBLEMS

Many would-be participants never get over the initial hump of learning to use a conferencing system. Connecting one's modem, figuring out how to use the communications package, setting communication parameters, dialing up the system, logging in, and navigating the conferencing system itself—every one of these is difficult the first (and second) time and is an opportunity to get snagged. A few technical problems, compounded with bad documentation and a general distrust of computers on the part of the user, have put a quick end to many a novice's conferencing career.

Our response to this was twofold. First, we decided that if the conference participants are not experienced with computers, then it is vital for the conference to have a technical support person who helps novice users with the conferencing system and with their own communications equipment and software (a handholding session is often the best way to get over the initial hump). The support person should be available whenever users have technical problems or questions.

Second, we have worked very hard to make the system as easy to understand and use as possible. We have kept the number of commands to a minimum. The metaphor of forum rooms and private offices helps tremendously because it makes it easy to picture what's going on when you're using the system. It's also worth noting that in trying to make the system simple I chose a command-driven structure rather than a menu-driven one, and that the commands are entire words, not single letters (actually, the words can be abbreviated, but we don't emphasize that fact to novices). It is generally assumed that menus with one-letter options are the most user-friendly way for an interactive program to work. However, this is really the case only when the program itself is the user's only resource for help. It is not the case when (1) the program is meant to be used often, at 1200 or 300 bits per second, and (2) there is someone to teach the user how to work the system. Under those conditions, commands are better because you don't have to sit through the menu display every time, and entire words are better because people who aren't computer experts relate better to words than to codes. This is a good example of how considering the human activities in the conference has affected the design of the software.

RELUCTANCE TO PARTICIPATE

Participants who do learn how to use the system often don't make any contribution to the discussion. They feel uncomfortable with the medium. After all, it can be scary to put your opinions and questions out in public view, when you can't even see who's reading your message and how they're responding to it. It's a disconcerting experience to write a message and get no acknowledgment back. What did people think? Was the message irrelevant? Was it dumb?

This, too, has affected our software design. First, we recognize the value of small scale in a conference. A huge enrollment contributes strongly to the anonymous feeling that makes people reluctant to participate. This is one of the main reasons why we were happy to run our conference on a microcomputer. It is also why Common Ground is not designed as an open-access system. One of the roles we envision in the running of a computer conference is the membership coordinator. This person decides who gets to participate in the conference and keeps in touch with members about whatever administrative issues arise. The membership coordinator is also the chief steward (participants can be given stewarding privileges, which enable them to add participants to the system, create and delete forums and groups, change people's passwords, and so on).

In addition to limiting scale, we have also consciously limited the function of the conferencing system: It is meant to be used for having discussions, not for exchanging computer programs, keeping databases, or archiving old messages. These are functions that would dilute the sense of community that helps to make good discussion possible and would also make the system more complicated to use.

Finally, the program expects every forum to have a moderator. Unlike the other roles listed here, moderators for the various discussions will normally be drawn from the general conference membership. Although the technique of moderating a computer-based conference is not yet well understood, writers on computer conferencing agree that it is very important to have a moderator who keeps discussions on track, elicits comments from participants, and ensures that everyone feels rewarded for their participation. In the Common Ground system, moderator privileges include moving messages in and out of the forum and editing the topic headers of messages in the forum so that they more clearly reflect message content.

CONTENT

The bottom line is this: If the content on the network isn't interesting and important to the participants, they won't participate. Yes, just communicating by computer is fun, and for some of us that's enough to hold our interest. But for most people, after the novelty has worn off, computer conferencing has to compete with other daily pressures. If they don't perceive the experience as worthwhile, they'll

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leave. In some cases this means that a computer conference isn't appropriate. Many computer-based conferences have failed because they simply didn't fulfill any pressing need for the participants. When a computer-based conference is appropriate, somebody needs to be concerned with maintaining worthwhile content. The "content coordinator" keeps watch over the discussions, arranges for special guests or events on the system, and in general tries to promote interesting and valuable discussion content in the system. This person is also the system's chief moderator.

After all this talk about human roles, it's still true that you can't have a computer conference if your computer isn't working. That's why a conference also needs a system operator. The sysop takes the system up and down, worries about hardware, and periodically runs file-maintenance routines. The Common Ground program starts up in operator mode. The operator can start a local Common Ground session at the console or put the program in wait mode (waiting for a call to come in). The operator can control monitoring of calls at the screen or at the printer. In addition, whenever a call is in progress the operator can "butt in"—that is, make the console share the remote user's input and output. This is intended mainly as a way to help novice users. It lets the operator type in commands for users, right before their eyes, and explain what's happening step by step.

PRINCIPAL DATA STRUCTURES

I developed Common Ground using Turbo Pascal on a DEC Rainbow Plus with a hard disk. The complete program is about 5000 lines long. The system's data is kept in three random-access files: the recipients file, the message directory, and the message-body file.

Each component of the recipients file is a Pascal record containing complete information about a recipient ("recipient" is the general term I use to mean a person, forum, or group—anything you can send a message to), including its full name and a list of its current message numbers, or, in the case of a group, its membership list. Every time a new recipient is added to the system, a new record is appended to the file. As you can see in figure 2, a recipient's position in the file (its component number) is used throughout the program to stand for that recipient.

The message directory contains all the information about messages except for their actual content. Each component is a record that holds the

(continued)

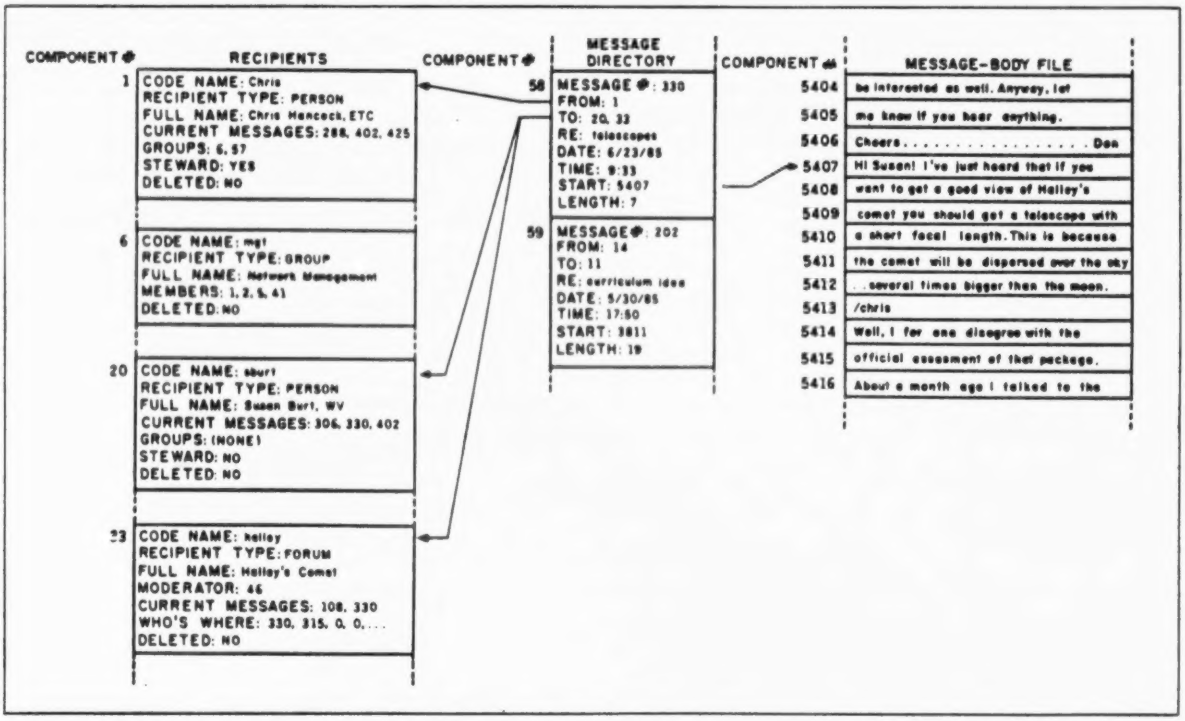
COMPONENT #
RECIPIENTS
1
CODE NAME: Chris
RECIPIENT TYPE: PERSON
FULL NAME: Chris Hancock, ETC
CURRENT MESSAGES: 288, 402, 425
GROUPS: 6, 57
STEWARD: YES
DELETED: NO
6
CODE NAME: mgt
RECIPIENT TYPE: GROUP
FULL NAME: Network Management
MEMBERS: 1, 2, 5, 41
DELETED: NO
20
CODE NAME: sburt
RECIPIENT TYPE: PERSON
FULL NAME: Susan Burt, WV
CURRENT MESSAGES: 306, 330, 402
GROUPS: (NONE)
STEWARD: NO
DELETED: NO
33
CODE NAME: halley
RECIPIENT TYPE: FORUM
FULL NAME: Halley's Comet
MODERATOR: 46
CURRENT MESSAGES: 108, 330
WHO'S WHERE: 330, 315, 0, 0, . . .
DELETED: NO
COMPONENT #
MESSAGE DIRECTORY
58
MESSAGE #: 330
FROM: 1
TO: 20, 33
RE: telescopes
DATE: 6/23/85
TIME: 9:33
START: 5407
LENGTH: 7
59
MESSAGE #: 202
FROM: 14
TO: 11
RE: curriculum idea
DATE: 5/30/85
TIME: 17:50
START: 3811
LENGTH: 19
COMPONENT #
MESSAGE-BODY FILE
5404 be interested as well. Anyway, let
5405 me know if you hear anything.
5406 Cheers . . . . Don
5407 Hi Susan! I've just heard that if you
5408 want to get a good view of Halley's
5409 comet you should get a telescope with
5410 a short focal length. This is because
5411 the comet will be dispersed over the sky
5412 . . several times bigger than the moon.
5413 /chris
5414 Well, I for one disagree with the
5415 official assessment of that package.
5416 About a month ago I talked to the

Figure 2: *An example of Common Ground's three data files, showing how the different components are linked to one another. The* WHO'S WHERE *entry in the* halley *forum is a list showing how far recipients have read. For example, the 330 in the first position indicates that recipient 1 has read up to message 330. The 315 in the second position indicates that recipient 2 has read up to message 315.*

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While the limit of one user at a time is not a serious one, it would obviously be nice to overcome it.

message's author, addressees, topic header, time and date of filing, and a pointer to the location in the message-body file where the text of the message can be found. Since messages are periodically purged and message numbers keep increasing throughout the life of the system, the entry for a message can't be stored in the component with the same number. Instead, the component number for a message entry is computed by a hashing function. Hashing collisions are resolved by the quadratic probe technique (if the component you want is full, look at the next one; if that's full, look at the one four positions away; if that's full too, look nine positions away, and so on).

The message-body file is a random-access file of strings containing the actual text of messages. It's a file of strings because you can't have random access to an ordinary text file; the components all have to be the same size. Because of the limit on the number of components in a random-access Pascal file (64,000), the message-body file is actually implemented as a sequence of files. Every time a message is sent, its text is appended to this file.

Let's look more closely at what happens when a message is sent. Suppose that user chris sends a message addressed to sburt (a person) and halley (a forum), as shown in the sample session in figure 1. Here's what happens:

- The body of the message is appended to the message-body file, and the message is assigned the next available number (330 in this example).
- 330 hashes to component 58 of the message directory, so the information about this message, including where its text can be found in the message-body file, is stored there.
- The number 330 is appended to the mail lists for sburt and halley in the recipients file.

When sburt logs in and types read new in her office, one of the messages she will see will be number 330. After displaying the message, Common Ground will ask her if it's okay to release it. If she says yes, the number 330 will be removed from her current message list; if not, it will be flagged as read (by changing it to a −330) so that it won't be displayed the next time she enters read new.

As time goes by, the system begins to fill up. Some of the recipients have been deleted by stewards and are using up space in the recipient file. Some messages are "dead," having been released from every room they were sent to. The purging process goes like this:

- The unused slots in the recipient file are freed for future use. This doesn't mean that any records are moved around in the recipients file. Instead, all references to the numbers of deleted recipients are changed. For example, suppose chris was deleted from the system and a new person, freida, was added in position 1. If message 330 were still around, it would now display as though it had been sent by freida. To avoid this, the purging process will change message 330's author from 1 to 0, which will display as -deleted-.
- A binary search tree of all active message numbers is built in main memory, containing all message numbers found in any active-message list in the recipients file.
- The program scans through the message directory, zeroing out the message numbers of messages that are no longer active and recording, in the active-message tree, the message-body file pointers for all active messages.
- The message-body file is collapsed, using the pointer information in the active-message tree. The text of active messages is moved back over the space occupied by inactive message text.
- The header file is rehashed because the entries for active messages might now be out of position due to collisions with messages that are no longer active.

WHAT YOU NEED

Common Ground will run on a DEC Rainbow (running MS-DOS version 2.11 or later) or an IBM Personal Computer or compatible. For a big conference and optimal response time, you should have a hard disk with between 1 and 10 megabytes devoted to the conference, but you can also have a decent conference with a pair of floppy-disk drives. A third floppy-disk drive will increase the maximum number of active messages from approximately 300 to 500. You'll also need an auto-answer modem that can run at 300 bits per second, 1200 bps, or both. The original Common Ground system was developed with a Multi-Tech 300/1200 modem, but it will also work with a Hayes 1200 and most compatible modems. [*Editor's note: The object code for Common Ground is available for downloading from* BYTEnet Listings *at* (617) 861-9764.]

FUTURE DEVELOPMENTS

While the limit of one user at a time is not a serious one for our present purposes, it would obviously be nice to overcome it. If and when multitasking MS-DOS and Turbo Pascal become available, it will be possible to have more than one user logged in at a time. However, the most exciting next step for the system—and one that doesn't have to wait for new technology—is the interconnection of Common Ground systems. This will allow participants on one system to send messages to participants on other systems, as users of FidoNet are currently able to do. It will also allow a joint forum discussion to be shared by two or more nodes. The actual message transfers will normally happen automatically at night, when phone rates are lower. ■

APPENDIX B

Case Studies of Four Teachers Use and Evaluation of the Science Teachers' Network

The following cases characterize four Science Teachers' Network members through analyses of their Network experience in terms of background, participation, and perceptions of the Network. The four cases are presented in order of log-in frequency, from frequent to infrequent.

JOHN

Background

After teaching physics for twenty years, this is John's first year teaching high school chemistry. He sees lack of preparation time as the major difficulty which science teacher's face today. While at school, John has the opportunity to speak with other teachers, including science teachers, several times per week. On the other hand, because of his lack of energy at the end of the day, he does not meet with science educators from other schools.

John is a fairly experienced computer user. Before using the Science Teachers' Network, however, he had no background in telecommunications. In preparation for using the Science Teachers' Network, he therefore attended one of the training sessions offered. The equipment he used was in his home and was left set-up throughout the year. Because of his location, John did not experience any phone costs as a result of his Network participation.

Network Participation

John was a member of the Science Teachers' Network for fourteen weeks. During this time he logged in 113 times for an average of one log-in per day. During these sessions, he wrote 159 messages, more than one per day. The ratio of his writing to reading of messages, 1:5, shows that John was one of the most active writers in the Network. He was also interested in all topics on the Network. His reading behavior shows a tendency to read across all forums; subject matter (chemistry, biology, earth science, physics), general (NB, litreview, biographies, system, calendar, software), and forums set-up for special guests; and to read all the messages in each. In addition, John extended the Network by posting print-outs of exchanges for other members of his department to read.

Of John's messages, 117 were sent through private mail and 42 to public forums. Most of John's public messages were sent to either the physics or chemistry forum (copies of these messages were sometimes sent to individuals), with occasional messages in general forums. The messages he wrote to public forums were very diverse in content and style. He introduced such topics as the "sociology of electrons", asked questions about chemical reactions, chemical storage, and textbooks; and more generally, he spoke of the importance of safety in schools. A review of these messages demonstrates that John asked questions as well as answered them, offered information, and became involved in ongoing discussions. Within messages, content revolved around science and science teaching, with particular emphasis on teaching strategies and materials.

The 117 messages John sent through private mail (this included copies of forum messages) went to thirty different members. He responded to 100% of the messages that were sent to him, while he received responses from only fifteen of the thirty members to whom he sent messages. Of these fifteen interactions, he had longer exchanges (a message chain where a member sends two or more messages and receives two or more messages from the same member*) with ten members and shorter exchanges (a message chain where a member sends one message and receives one message from another member**) with the remaining five.

Views of the Network

In response to the question, "How did the Network serve your interests", John said that he saw "Networking as an opportunity to spread information on physics and chemistry", adding that he felt as if he had "broken out" of his previous confinement to collegial exchanges only within his own school. He mentioned that he felt that the Network was an ideal way of being in touch with other teachers because it did not require a lot of time and energy at the end of a busy day. In addition, John saw the Network as giving the opportunity to "spread information and ideas without having to meet with others." He felt that he had gotten involved in extended discussions on the Network and had obtained useful information which he was able to apply to his classroom practice.

John responded that he had not been able to get to know any member exclusively through Network interactions and that he was disappointed that he sometimes did not get responses to his messages. Further, he stated that of the responses he did receive, they often appeared in his personal mail.

Interpretation

John's frequent use of the Network might be attributed to a combination of easy access to equipment and his growing involvement in Network discussions. Although equipment access may have facilitated his logging-in, his comments suggest that the promise of communication with colleagues was perhaps the key motivator for John's Network participation. His interest in interaction is apparent in his disappointment by the lack of response he received to messages, by his feeling that the contact he did achieve with colleagues made him feel that he had "broken-out", and by his 100% response rate to others who wrote to him.

John's strong involvement in the Network is seen not only in the frequency of his log-ins, but also in his reading and writing behavior. Not only did John read most messages, he also wrote a great variety of public messages and had ongoing discussions with ten members.

JEAN

Background

Jean teaches general science in a small middle school (grades 7 & 8) with a student population of 170. In response to the survey of members' interests, she stated that she is interested in keeping up with current science events. While discussing with us in the interview her idea of major problems that science teachers face, she twice cited lack of time as a major difficulty. Jean said that she has colleagues both in her school and at other schools with whom she can talk about science and science teaching. Discussions with colleagues at her school occur both formally (e.g. meetings and training sessions) and informally, occur at least once a week. She sees colleagues outside her school less frequently -- speaking with them at formal occasions a couple of times a term.

When Jean joined the Science Teachers' Network she was had previously met nineteen of the members. She had spent more than five minutes speaking with five of them, and less than five minutes with the remaining fourteen. Her experience with computers was quite extensive, but did not include telecommunications. She was able to attend one of our training sessions, but continued to have difficulty using her communications software. Her equipment was set-up at home and was left up throughout the year. Because of her location, Jean experienced no phone costs.

Network Participation

Jean was a member of the Science Teachers' Network for 24 weeks. During this time she logged-in 39 times, with a drop-off in participation during February and March, and picking up again in April, May, and June -- yielding an average of almost two log-ins a week.

Jean wrote 36 messages and read 655, for a reading-writing ratio of 18:1, which was about the median for this index. When reading messages she tended to read all the messages in the chemistry and physics forums, slightly fewer in earth science and biology, and avidly within the general and guest forums. In addition, Jean extended the Network through discussions with her colleagues and by posting print-outs of Network exchanges in her science office.

Examination of Jean's writing acts reveals that she sent only eight messages to public forums, whereas 28 messages were sent through private mail (including copies sent to forums). In particular, the majority of her public messages were sent to the more general forums. Jean limited her public entries to asking questions about using her computer equipment, advertising a teaching job, and asking about a chemistry book.

Jean's 28 private messages were sent to 13 different members, to which she received 24 responses from 11 recipients. She had ongoing exchanges* with five members, and shorter exchanges** with six members. Jean was previously acquainted with two of the five members with whom she had ongoing discussions.

Views of the Network

When asked about her experience with the Network, Jean said that she thought it took the entire year to become comfortable and get started with the Network. She stated that the Science Teachers' Network gave her easy access to colleagues outside her own school, made her feel part of a larger community, and allowed her to get to know new colleagues from Network interactions. Further, Jean saw the Network as useful for exchange of information and discussions in order to broaden her ideas and background. When asked about how she thought the Network could be improved, Jean said that "there was a need for input from a greater variety of members".

Jean thought that she took from the Network more than she gave -- saying that by the time she had finished reading she was out of Network time. She was interested in many of the discussions, but did not feel that she was qualified to contribute to those that went beyond her knowledge of general science
(she did not teach high school science).

Interpretation

Jean's participation was somewhat more limited that John's, but still was in the top quartile (two log-ins a week). While Jean's access to equipment was as easy as John's, her comments suggest that her motivation for participation was weaker. Although the Network made Jean feel that she had become part of a larger community and that she had broadened her ideas and background, a number of factors may have influenced her experience of the Network and subsequent motivation for participation. Specifically, Jean became a passive participant in the Network; admitting that she often took more than she gave. One reason Jean may have been unable to get involved to the extent she had anticipated, was because of the specificity of the message content in the subject matter forums. Although Jean read most of the messages in these forums, her unfamiliarity with these areas could have made her feel unable to contribute to the discussion. Even though Jean said she was more familiar with the topics in general forums, she still tended only to read messages. The source of her passivity in this case, rather than message topic, may have been her feeling that she only had time for reading during her sessions. Even though Jean's contributions to forums were limited, she was able to establish ongoing discussions* with five other members.

TED

Background

Ted teaches chemistry in a large suburban high school. In the past he has also taught physics and physical science. When speaking about the major problems that science teachers experience, he mentioned of a "lack of time to do everything I want to do" and difficulties keeping up with science. Ted has colleagues at school with whom talks about science and science teaching, but only has the opportunity to speak with them a couple of times a month, and at formal settings. Outside of school, interactions with colleagues occur, both informally and formally, on a monthly basis.

Before becoming a Network member, Ted knew 13 members other members. He had spoken with five members for five minutes or more, and had less or no face-to-face contact with the remaining eight. Ted had experience with computers, but not with telecommunications. In preparation for Network participation, he therefore attended one of our training sessions. The computer which Ted used for Network participation was at home. He could not, however, leave it set-up. Rather, he had to connect his equipment together for each log-in. Though calling from home was not a toll call for him, Ted said that having to set-up his equipment greatly deterred his participation.

Participation

Ted was a Network member for 22 weeks. During this time period he logged-in 12 times, for a rate of approximately one log-in every two weeks, about average. However, he wrote 21 messages, about one per week, which keep him in the first quartile of activity in terms of his writing behavior. He read 467 messages, and his writing:reading ratio was 22:1, a bit below the median on this index. When reading in the subject matter forums, Ted tended to read all the messages in chemistry, most of the entries in physics, and none of the messages in biology or earth science. Within the more general forums he was an avid reader (read all the messages) in all but the literature review forum. With the exception of the PBSEARTH forum, he also read all the messages written by guests. During his membership, Ted extended the Network by posting print-outs and discussing Network exchanges with other members of his department.

Of his 21 messages, thirteen were sent to individuals and nine to public forums. Three of the nine public messages were sent to the chemistry forum, while the remaining six were sent to a variety of forums. In general, Ted's messages either asked a question or offered unsolicited information about teaching materials or science information. The nature of his entries in public forums, however, demonstrated little personal involvement, in that they were restricted in content, style, and personal involvement.

Ted's 13 private messages were sent to six different members, whereas he received 11 responses from four members. He had ongoing exchanges* with three members and a shorter exchange** with one member. Of the three members with whom he had ongoing exchanges, Ted was previously acquainted with two.

Views of the Network

Ted said that everything on the Network was useful. Specifically, he saw the Network as valuable for exchanging information and for discussion of labs. Moreover, he was able to apply some of this information to his classroom. His participation made him realize that other teachers share the same problems and concerns that he does. In addition, Ted thought that he was able to get to know some Network members through his Network interactions alone.

Interpretation

Ted's positive comments reflect a strong interest in spite of his limited log-ins. Just two log-ins a month led Ted to believe the Network was valuable for obtaining information, getting to know others, and for sharing perspectives with other teachers. Unfortunately, the necessity of setting-up his equipment seemed to severely deter Ted's participation. His motivation to participate can be inferred from the pattern of reading and writing. In particular, Ted wrote twenty-one messages in twelve log-ins, read all messages in all forums except earthsci and biology, and had ongoing exchanges* with three members.

JEFF

Background

Jeff teaches high school physics and is interested in science demonstrations and obtaining new science information. He does not have access to colleagues at school, but is able to speak with colleagues from other schools, both formally and informally, at least once a week. Jeff previously knew, at least by name, 20 of the Network members. When beginning to use the Network, Jeff attended one of the training sessions offered. Throughout his use of the Network, Jeff was borrowing equipment and only had access to it for one hour at a time. This access limitation may have led to Jeff's feeling that he was only just getting started with the Network at the end of this year. Once ready to purchase his own equipment, Jeff experienced difficulties selecting, obtaining and using his modem and communications package. Fortunately, by the end of this year, he had obtained and mastered his own equipment at home.

Network Participation

Jeff was a member of the Network for 14 weeks and logged-in only twice during this time. He did, however, write at least one message during each of his two sessions. Jeff did most of his reading in the physics forum and a small amount in the other forums. The biology, earth science, and guest forums were left unread.

Jeff wrote three messages (one to the physics forum and two through private mail). The one public message was an announcement of his success in finally using the Network. Within private mail, he sent two messages to two different members, and received six messages from five members -- leaving three members without a response. He had no ongoing exchanges*, but did have shorter exchanges* with two members with whom he was previously acquainted. In his two log-ins he read 43 messages, yielding an average ratio of reading:writing. But his rate of logging in, reading and writing were all below average.

Views of the Network

Jeff saw the Science Teachers' Network as a morale booster, as reducing feelings of isolation, and as providing an occasion for exchange of information. He said that the Network gave teachers the opportunity to share "a little bit of everything". Jeff thought the Network dealt directly with isolation by giving access to other teachers, an opportunity he thought was not available within his own school. In addition, he was excited by the fact that he got new teaching ideas from the Network and was able to use them. He was also able to extend the Network by discussing message content with fellow teachers. Even through his limited Network use, Jeff felt he was able to develop new acquaintanceships through Network interactions alone.

Interpretation

Jeff's experience with the Science Teachers' Network seems somewhat similar to Ted's. Jeff's equipment limitations were more serious, but he shared Ted's motivation for participation. Although having only two log-ins prevented Jeff from getting involved in any discussions, he thought the Network reduced feelings of isolation and provided a necessary vehicle for exchanges of information. Ted made the best use of his sessions by reading as many messages as possible, with an emphasis on his subject area (physics), and by writing at least one message. Thus, although Jeff was motivated to log-in and become involved, his lack of equipment limited his participation.

Trends

A review of the four cases suggests patterns in background, participation, and perceptions of the Network. The background of the four teachers was similar in a number of ways. Of the teachers described, none had any experience with telecommunications, most claimed that time is a major difficulty for teachers, and they all had fairly limited informal contacts with teachers outside their school.

The teacher's access arrangements and comments confirm that access plays a key role in determining participation, as found in the quantitative analyses of the complete sample. In these cases, the easier the access, the greater the participation. John for example, had very easy access, and logged in frequently. Jeff and Ted, on the other hand, had inconvenient access, and mentioned that this affected their participation. The role of topic is also illustrated in the case of Jean: Jean had good access, but claimed that she was unable to respond to the topics in the subject matter forums and therefore became a passive member. There may be an interaction between topic and access, where good access combined with high topic interest leads to the greatest participation, while difficult access together with low interest in the topic produces a very low log-in rate.

The case studies also suggest that easy access and frequent log-ins may lead to more diverse participation. John, for example, tended to contribute more diverse messages than the other members described, both in terms of content and style. The more limited participation of other members, on the other hand, led to restricted message writing, where members entered "tidbits" of information, and limited themselves to questions, answers, and information offering. The cases also suggest that reading behavior was influenced by log-in frequency. In the cases reviewed, it seems that more logs-in permits "omnivorous" reading. These cases and the analysis of the complete sample show that a frequent user reads every message in every forum, whereas an infrequent user reads only those messages in their subject area. It was encouraging to find that each of the four teachers expanded the Network by posting print-outs of exchanges.

The case studies also revealed a number of other trends which also were demonstrated in the quantitative analyses on the complete sample of teachers. Teachers tended to do much more reading than writing of messages, to send more private mail than public, and to discuss the teaching of science, rather than science itself.

When asked about their views of the Network, the four teachers often mentioned that the Network gave them easy access to other teachers and to information, and that they could use what they learned in the classroom. Disappointment occurred only when teachers felt that others were not contributing to the Network by making entries or responding to their messages. Finally, the cases showed that even infrequent users expressed enthusiasm about the Network and its potential.

APPENDIX C

Teacher Telephone Interviews

1. First interview, after the third log-in
2. Second interview, after the end of the term

THIRD LOGON PHONE INTERVIEW version 2/20/86

Interviewer_________ Network Member____________________
Today's Date________
1st Logon Date________

I. Introductory remarks...

II. DO YOU HAVE ANY QUESTIONS THAT WE COULD HELP WITH? [Interviewer should write in appropriate spaces below any information relevant to our technical or professional information questions, and take notes on other points mentionned]

[Interviewer: if member has not entered Biog on-line, remind them]

III. Technical: Network and other computing experience so far:

A. Equipment, access, type of use:

If member didn't have all equipment when given password:
I SEE YOU DIDN'T HAVE ALL YOUR EQUIPMENT BEFORE -- ABOUT WHAT DATE DID YOU HAVE ALL YOUR EQUIPMENT?

I SEE YOU'VE GOTTEN ON THE NETWORK ABOUT ___ TIMES. WE'D LIKE TO UPDATE OUR RECORDS ABOUT YOUR EQUIPMENT AND ASK ABOUT ANY DIFFICULTIES YOU'VE EXPERIENCED. [Ask if not yet stated]

Phone: WHERE IS THE PHONE LINE YOU USE?

If home: SO YOU PAY FOR THE CALLS YOURSELF?

If school: IS IT EASY FOR YOU TO GET TO THE PHONE LINE YOU USE? (elicit explanation of location and ease of access to phone)

If no: WHAT DO YOU HAVE TO DO TO GET TO THE PHONE?

DO YOU HAVE TO WAIT TO USE THE PHONE?

Time: IS IT HARD FOR YOU TO FIND TIME IN YOUR DAY TO LOG IN?

ABOUT HOW OFTEN HAVE YOU BEEN LOGGING IN?

Type of Use

DO OTHER MEMBERS OF YOUR DEPARTMENT LOG ON TO THE NETWORK USING YOUR CODENAME?

DO YOU EVER ASK QUESTIONS AND/OR USE THE NETWORK IN ORDER TO PROVIDE INFORMATION TO OTHER MEMBERS OF YOUR DEPARTMENT?

Other equipment: SO YOU'RE USING THE _____ COMPUTER WITH THE ___ MODEM (etc., refer to application)

[Update if different]

Computer: Where located:

DO YOU HAVE ACCESS TO THIS COMPUTER AT THE TIMES YOU LIKE?

Modem:

Communications Software:

Printer:

B. Getting on

[Interviewer -- chose appropriate wording]
DID YOU HAVE ANY [OTHER] [PARTICULAR] DIFFICULTIES GETTING STARTED?

[Interviewer check problems mentioned and explain below]

Had problems with

___selecting/obtaining hardware & software:

___using communications software:

___can't get past building switchboard
___get busy signal often when calling
___get connect message but not into CG
___using Common Ground:

___other:

C. Previous computer experience: WHAT KINDS OF COMPUTER USE WERE YOU MOST FAMILIAR WITH BEFORE THIS [HAD YOU USED COMPUTERS BEFORE THIS?]

___modem use(explain)
    ___uploading/downloading data

___word processing
___LOGO or other programming
___computer as measurement tool
___spreadsheets/databases
___educational software other than the above: (list examples)

___other

[Interviewer:
Inquire about each item above and code:

0=no
1=do it self
2=have taught children in classes
3=have taught adults in classes
4=have taught both in classes]

HAVE YOU TRIED SAVING MESSAGES TO DISC AND PRINTING THEM OUT?

HAVE YOU TRIED UPLOADING TO THE NETWORK?

HAVE YOU USED ANY OF THE NESSAGE EDITING FEATURES?

WHEN YOU LOGON, WHAT DO YOU USUALLY DO FIRST -- READ YOUR OWN MAIL OR VISIT FORUMS?

[If member is having difficulty, give suggestions here. Write here what was suggested:

Assistance and training sources:
WE'RE ALSO WONDERING WHAT TRAINING MATERIALS OR OTHER RESOURCES YOU USED
.

[review casually the list below, asking at the end which seemed especially helpful]

Code: 1=used 2=found especially helpful

___attended Dec. training meeting
___attended Jan training meeting
___has called office for phone help
___has received butt-in help
___one page summary
___manual: DO YOU HAVE ANY SUGGESTIONS FOR MANUAL?

___standup card
___talked to other Network users
___get help from computer people at school
___posted need for help on network
___other (list)

DID YOU FIND ANY OF THESE MATERIALS OR RESOURCES ESPECIALLY HELPFUL?

DO YOU HAVE ANY [OTHER] SUGGESTIONS FOR IMPROVING TRAINING?

IV. Professional Work

We'd also like to learn more about your work.

A.[If subject areas ambiguous: I NOTICED ON YOUR APPLICATION FORM THAT YOU TEACH ________....]

B. IN YOUR TEACHING WORK, WHAT DO YOU CONSIDER TO BE THE MAIN PROBLEMS SCIENCE TEACHERS FACE?
[Interviewer takes notes, listing items in order of mention, taking notes on any details on the first three items]

[If member asks "what do you mean?": IT CAN BE ANY ASPECTS OF YOUR WORK THAT COME TO MIND AS PROBLEM AREAS -- THE QUESTION IS MEANT TO HELP US UNDERSTAND YOUR OWN CONCEPTIONS ABOUT YOUR WORK.]

[If member asks "do you mean x?": NOT NECESSARILY, "   "   ".

Coding (method to be confirmed later):
___Keeping up on science
___Keeping up on science teaching
___Lack of colleagues
___Problems with school administration
___Problems with student motivation, discipline, ability
___low pay
___lack of time
___others: list

C. MANY TEACHERS REPORT THAT THEY FEEL ISOLATED FROM COLLEAGUES AND FROM NEW DEVELOPMENTS IN SCIENCE. WHAT IS YOUR EXPERIENCE?

If yes: IN YOUR CASE, WHAT DO YOU SEE AS THE CAUSE OF BEING ISOLATED?

WHAT COULD HELP TO RELIEVE THIS?

If no: IN YOUR CASE, WHAT DO YOU SEE AS PREVENTING YOU FROM BEING ISOLATED?

WHAT COULD HELP TO RELIEVE ISOLATION OF OTHER TEACHERS, IN YOUR VIEW?

[Interviewer choose wording below as appropriate]
D. WHAT SOURCES HAVE YOU USED OR FOUND HELPFUL FOR TEACHING IDEAS?
[OR could you tell me more about (any other) sources you find helpful for...]

E. WHAT SOURCES HAVE YOU USED OR FOUND HELPFUL FOR LEARNING ABOUT ONGOING DEVELOPMENTS IN SCIENCE? [OR could you tell me more about...]

F. DO YOU FIND YOU HAVE COLLEAGUES AT SCHOOL WHOM YOU TALK TO ABOUT SCIENCE OR SCIENCE TEACHING?

If no: IS THAT BECAUSE THERE IS NO ONE ELSE AT SCHOOL IN YOUR FIELD? [This is meant to prompt real reason]

If yes: IS THIS INFORMALLY, OR AT DEPT. MEETINGS OR OTHER EVENTS?

DO THESE PEOPLE TEACH THE SAME SUBJECT THAT YOU DO?

ABOUT HOW OFTEN DO YOU FIND YOU HAVE THE OPPORTUNITY TO TALK WITH OTHERS?

Check coding form:

	Occasion	
Frequency	Informal	Dept meetings,training
once a week or more		
several times per month		
several times per term		
few times per year		
rarely		
never		

G. DO YOU FIND YOU HAVE COLLEAGUES OUTSIDE OF SCHOOL WHOM YOU TALK TO ABOUT SCIENCE OR SCIENCE TEACHING?

If no: IS THAT BECAUSE .... (This is meant to prompt real reason)

If yes: IS THIS INFORMALLY, OR AT DISTRICT MEETINGS OR PROFESSIONAL CONFERENCES?

DO THESE PEOPLE TEACH THE SAME SUBJECT THAT YOU DO?

ABOUT HOW OFTEN DO YOU FIND YOU HAVE THE OPPORTUNITY TO TALK WITH OTHERS?

Check coding form:

	Occasion	
Frequency	Informal	Meetings, training
once a week or more		
several times per month		
several times per term		
few times per year		
rarely		
never		

V. Other Suggestions and Opinions [Ask directly if not already suggested, or probe previous suggestions]

A. FROM YOUR EXPERIENCE SO FAR, WHAT USES DO YOU SEE WITH NETWORKING TO HELP TEACHERS?

B. WHAT PROBLEMS DO YOU SEE?

C. ANY OTHER SUGGESTIONS?

THANKS!....

JULY PHONE INTERVIEW
VERSION 7/25/86

Network member ______________________________

Date of interview____________ Interviewer______________

I. Introductory Remarks

WE ARE NOW TRYING TO UNDERSTAND FROM NETWORK MEMBERS THEIR IMPRESSIONS OF THE NETWORK AND IF NETWORKS FOR TEACHERS MIGHT BE USEFUL IN THE FUTURE. WE WOULD APPRECIATE YOUR HELP AND WOULD LIKE TO TALK WITH YOU BY PHONE FOR ABOUT TWENTY FIVE MINUTES. IF THIS A TIME WHEN YOU ARE WILLING TO DO THAT?

WE ARE IN THE PROCESS OF WRITING A REPORT ABOUT THE NETWORK WHICH WE WILL SEND YOU WHEN IT IS FINISHED IN OCTOBER. TO HELP US UNDERSTAND THE POTENTIAL USES OF COMPTER BASED CONFERENCING, WE WOULD LIKE YOU TO TALK FRANKLY WITH US ABOUT YOUR IMPRESSIONS OF THE NETWORK AND ANY EXPERIENCE YOU HAVE HAD WITH IT.

II. Questions

1. HOW HAS THE NETWORK SERVED YOUR INTERESTS, AND NOT SERVED YOUR INTERESTS THIS YEAR?

(Try to get full list first, then probe items on list)

1.1 First item mentionned:

1.2 Second " "

1.3 " " "

1.4

1.5

Suggested probes:

OH THAT'S INTERESTING; CAN YOU TALK A LITTLE MORE, EXPLAIN A LITTLE MORE ABOUT THAT?

OH...WHAT ABOUT THAT DID YOU LIKE?

1.1

1.2

1.3

1.4

1.5

2. DID YOU FEEL YOU REALLY GOT INVOLVED IN ANY EXTENDED DISCUSSION?

3. WHAT IS YOUR FAVORITE FORUM? COULD YOU SAY SOMETHING ABOUT WHY YOU LIKE IT?

4. ARE THERE ANY FORUMS THAT YOU DECIDED NEVER TO VISIT? COULD YOU SAY SOMETHING ABOUT WHY THAT IS THE CASE?

5. HOW ABOUT PERSONAL MAIL...WHAT KINDS OF USE DID YOU MAKE OF THAT?

   WHAT DID YOU TALK ABOUT IN PERSONAL MAIL?

6. DID YOU GET ANY TEACHING IDEAS, NEW SCIENCE INFORMATION OR AN UPDATE ON MATERIALS THROUGH THE NETWORK?

   DID YOU MAKE USE OF ANY OF THESE?

   If yes: COULD YOU GIVE AN EXAMPLE OF SOMETHING YOU TRIED?

   If no: ARE THERE SOME IDEAS YOU MIGHT TRY IN THE FUTURE?

7. DID YOU FEEL THAT YOU GOT TO KNOW ANYONE BY INTERACTING WITH THEM ON THE NETWORK, OR PERHAPS BY JUST READING THEIR MESSAGES?

If yes: AS A RESULT OF YOUR NETWORK INTERACTIONS DID YOU DEVELOP ANY FACE TO FACE CONTACTS OR ACTIVITIES WITH ANYONE?

DID YOU PERHAPS RE CONNECT WITH SOMEONE ON THE NETWORK YOU KNEW PREVIOUSLY BUT HAD NOT TALKED WITH FOR A WHILE?

8. ABOUT YOUR EQUIPMENT, WHEN YOU FIRST LOGGED IN IN (month) WAS YOUR EQUIPMENT THE SAME AS IN JUNE?

Original equipment:
WAS YOUR COMPUTER AT HOME OR AT SCHOOL?

If home: DO YOU LEAVE IT SET UP?
If school: WHAT DO YOU HAVE TO DO TO GET READY TO LOG IN?

If different equipment in JUne, ask again about June equipment:
WAS COMPUTER AT HOME OR SCHOOL?

If home: DO YOU LEAVE IT SET UP
If school: WHAT DO YOU HAVE TO DO TO GET READY TO LOG IN?

Coding checklist for equipment:

Original equip	June equip if different
__Home	__Home
Equip needs hooking up	Equip needs hooking up
__never __sometimes __always	__never __s'times __always
__School	__School
Distance to equip	Distance to equip
__same room __other room	__same room __other room
Time equip available	Time equip available
__always __sometimes __rarely	__always __stimes __rarely
Equip needs hooking up	Equipment needs hooking up
__never __sometimes __always	__never __s'times __always
__Elsewhere (explain)	__Elsewhere (explain)

---

9. HAVE YOU PERSONALLY HAD ANY PHONE COSTS THROUGH YOUR NETWORK PARTICIPATION?

HAVE THEY AFFECTED YOUR PARTICIPATION IN ANY WAY?

10. WE KNOW THAT SOME MEMBERS EXPANDED THE NETWORK BY POSTING NETWORK PRINTOUTS, OR ELICITING QUESTIONS FROM OTHERS IN THEIR DEPARTMENT, OR IN OTHER WAYS. WERE ANY OTHERS BESIDES YOU IN TOUCH WITH THE NETWORK IN THAT WAY?

11. WHAT DO YOU SEE AS THE BEST USES OF THIS NETWORK FOR SCIENCE TEACHERS?

THANK YOU SO MUCH.....WE HAVE PROPOSED THAT THE NETWORK OPERATE FOR ANOTHER YEAR AND IF YOU ARE INTERESTED,AND IT IS FUNDED, WE WOULD WELCOME YOUR PARTICIPATION.

APPENDIX D

Acquaintanceship Questionnaire

April 23, 1986

Dear Science Teachers' Network Member:

Please assist our research on the Science Teachers' Network, and help other future networks, by completing the attached questionnaire. This information will help us to understand communication patterns among members. As you may know, you will receive a complete report on this and all the other analyses about the network in the early fall.

For each name on the attached list, please check your answer on two scales. Think back to BEFORE you logged on to the network.

Scale A: ACQUAINTANCESHIP: check one of the following categories:

- O: When I first logged on to the network, I had never heard of this person.
- N: When I first logged on to the network, I had heard of NAME only and never seen him/her in person.
- S: When I first logged on to the network, I had SEEN person only and never talked with him/her.
- T-: When I first logged on to the network, I had TALKED with him/her very LITTLE (less than 5 mins.total)
- T+: When I first logged on to the network I had TALKED with him/her some or ALOT (5 mins. or more total)

Terms:

"talked with": had a verbal exchange in person or by phone, or as part of a small group interacting with person, even if you personally didn't talk with person.

"five minutes or more": a total of roughly five minutes or more in your whole life.

(over)

Scale E: KNOWN AS EXPERT: If you had heard of the person, check one of the following. (If your answer to Scale A is 0, you may skip this scale.)

E: When I first logged on to the network, I had heard that this person was known to others as an EXPERT science teacher, scientist, or educator (in science or other fields).

P: ...Possibly a known expert/I'm not sure/ I don't think person is known as expert.

Terms:

"known to others as an expert...": your impression was that the person had some reputation or was recognized by others to be an expert (whether or not you agree that they are expert).

"science teacher, scientist, educator": your own definition of these terms is acceptable for the purposes of this questionnaire.

Although we don't consider this information any potential source of embarrassment, we still want to insure the maximum confidentiality of your responses, and also don't want our knowledge of your responses to bias any of our own analyses. Therefore we ask you to write your name only at the bottom of this page. As soon as we receive it back, we will write a code number on the actual questionnaire without looking at the responses (we promise!). The questionnaire will be identified only with a code number as it is being analyzed.

This should take 5-15 minutes to complete. Please mail these pages back to us in the enclosed stamped envelope by May 2, and many many thanks for your help!

------------------------------------ ---------------
Your name Date

For each person, please check one category on each scale.

When I FIRST logged on to the network, to me this person was:
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T-:had talked <5 mins. T+:had talked >5 mins.
EXP: E:a known expert P: possibly a known expert, or not a known expert

---

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
betty - Betty Bjork, EDCO	--	--	--	--	--	--	--
rrh - Robert R. Hall, Nantucket High School	--	--	--	--	--	--	--
greg - Greg Jackson, Harvard Graduate School of Ed.	--	--	--	--	--	--	--
johns - John Strand, Superint't of Schools, Newton,MA	--	--	--	--	--	--	--
gus - Augustus Pesce, Superint't of Schools, Ware,MA	--	--	--	--	--	--	--
dan - Dan O'Connor,Superint't of Schools, Watertown,MA	--	--	--	--	--	--	--
peterp - Robert Peterkin, Superint't, Cambridge, MA	--	--	--	--	--	--	--
jimpres - Jim Prescott, Ayer High School	--	--	--	--	--	--	--
judy - Judith Sandler, EDCO	--	--	--	--	--	--	--
philz - Philip Zohdiates, Education Development Center	--	--	--	--	--	--	--
lenny - Lenny Lindstrom, Texas A&M College of Education	--	--	--	--	--	--	--
basque - James Amara, Minuteman Tech	--	--	--	--	--	--	--
kilburn - Robert E. Kilburn, Newton Public Schools	--	--	--	--	--	--	--
kim - Kim Storey, WGBH	--	--	--	--	--	--	--
smlon - Stephen Lonsdale, Natick High School	--	--	--	--	--	--	--
victor - Victor Schmidt, University of Pittsburgh	--	--	--	--	--	--	--
renee - Renee Hobbs, Dept. Communications,Babson Col.	--	--	--	--	--	--	--
peter - Peter Segal, Concord-Carlisle High School	--	--	--	--	--	--	--
stone - Martha Stone Wiske, ETC	--	--	--	--	--	--	--
juliea - Juliet Amaral, New Bedford High School	--	--	--	--	--	--	--
bobs - Robert W. Sandos, Montachusett Regional. Voc. H.S	--	--	--	--	--	--	--
campbell - David Campbell, Abington High School	--	--	--	--	--	--	--

For each person, please check one category on each scale.

When I FIRST logged on to the network, to me this person was:
ACQ: O:unknown   N: I knew by name only   S:knew by sight, never talked
T-:had talked <5 mins.   T+:had talked >5 mins.
EXP: E:a known expert   P: possibly a known expert, or not a known expert

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
sgerome - Stephen J. Gerome, Memorial H.S., Tewksbury	--	--	--	--	--	--	--
red - Robert Davis, North High School, Worcester	--	--	--	--	--	--	--
sandy - Harold Sandy Wiper, Newton North High School	--	--	--	--	--	--	--
pgast - George Pendergast, Tahanto Regional High School	--	--	--	--	--	--	--
helen - Helen Young, Winsor School, Boston	--	--	--	--	--	--	--
immoody - Irene Moody, Montachusett Regional Voc. H.S.	--	--	--	--	--	--	--
david - David Parfitt, Brookline High School	--	--	--	--	--	--	--
stu - Stuart Rist, Newton North High School	--	--	--	--	--	--	--
eileen - Eileen McSwiney, EDCO	--	--	--	--	--	--	--
woody - Woody Pidcock, HGSE Midcareer Math & Science	--	--	--	--	--	--	--
kay - Kay Merseth, Dir.MidCareer Math and Science,HGSE	--	--	--	--	--	--	--
bob - Bob Stewart, New Preparatory School, Cambridge	--	--	--	--	--	--	--
tommac - Thomas Maccarone, Swampscott High School	--	--	--	--	--	--	--
cath - Catherine Krueger, Bedford High School	--	--	--	--	--	--	--
skerret - Patrick Skerrett, St. Mark's School	--	--	--	--	--	--	--
mar - Michael A. Rinaldi, Bedford Schools	--	--	--	--	--	--	--
davey - David McNamara, Concord-Carlisle High School	--	--	--	--	--	--	--
chrism - Christine Monroe, Burgess School, Sturbridge	--	--	--	--	--	--	--
abedard - Arthur Bedard, Canton High School	--	--	--	--	--	--	--
bryan - Bryan Davis, Leicester High School	--	--	--	--	--	--	--
jaks - James Kaufman, Prof.of Chemistry and Lab Safety consultant	--	--	--	--	--	--	--
monroe - Robert Monroe, West Bolyston High School	--	--	--	--	--	--	--

For each person, please check one category on each scale.

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ACQ: O:unknown   N: I knew by name only   S:knew by sight, never talked
     T-:had talked <5 mins. T+:had talked >5 mins.
EXP: E:a known expert   P: possibly a known expert, or not a known expert

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
jgfm - James Frank-Mills, Dracut High School	--	--	--	--	--	--	--
jud - Jud Hill, Jamaica Plain High School	--	--	--	--	--	--	--
gb - George Blakeslee, Weston High School	--	--	--	--	--	--	--
anne - Anne Adams, Lunenburg High School	--	--	--	--	--	--	--
bruce - Bruce Seiger, Wellesley Senior High School	--	--	--	--	--	--	--
tomv - Thomas Vaughn, Gibbs Junior High School	--	--	--	--	--	--	--
jcl - Jeff Lane, Tri-County Vocational	--	--	--	--	--	--	--
phipps - William Phipps, Medway High School	--	--	--	--	--	--	--
tim - Timothy Thomas, Andover High School	--	--	--	--	--	--	--
wizard - Steve Cremer, Braintree High School	--	--	--	--	--	--	--
rose - Rosemary Rak, Taunton High School	--	--	--	--	--	--	--
jimb - James Banks, Danvers High School	--	--	--	--	--	--	--
bg - Bruce Gregory, Harvard Astrophysical Observ.	--	--	--	--	--	--	--
irwin - Irwin Shapiro, Harvard Astrophysical Observ.	--	--	--	--	--	--	--
markmhs - Mark Greenman, Marblehead High School	--	--	--	--	--	--	--
charlie - Charles R. Waugh, North Quincy High School	--	--	--	--	--	--	--
vic - Victor Kourey, Leicester High School	--	--	--	--	--	--	--
alfred - Alfred J. Slowe, North Attleboro High School	--	--	--	--	--	--	--
rwewing - Robert Ewing, Montachusett Reg. Voc. School	--	--	--	--	--	--	--
maurice - M. Andy Sorenson, Chelmsford High School	--	--	--	--	--	--	--
johnb - John R. Burton, Champlain Coll., Burlington, VT	--	--	--	--	--	--	--
mariane - Marianne Nelson, Buck.,Brown & Nichols School	--	--	--	--	--	--	--

For each person, please check one category on each scale.

When I FIRST logged on to the network, to me this person was:
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T-:had talked <5 mins. T+:had talked >5 mins.
EXP: E:a known expert P: possibly a known expert, or not a known expert

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
jroper - John Roper, Assabet Valley Reg. Voc. Sch.							
daveoh - David O'Hearn, Burlington High School							
chuck - Charlie Johnson, Concord Middle School							
bunsen - Rick Doyle, Braintree High School							
don - Don DeFelice, Minuteman Tech.							
tad - Thomas J. Brown, Walpole High School							
fergie - Scott C. Ferguson, Everett Schools							
george - George Hines, Whitman-Hanson Reg. H.S.							
bobgda - Robert Reed, Governor Dummer Academy							
cju - Candace Julyan, ETC							
love - Joel Lovering, Brennan Middle School							
btinker - Robert Tinker, Tech.Educ.Research Center (TERC)							
ken - Ken Haskins, Harvard Graduate School of Ed.							
bel - Belvin Williams, PRIME Computer/Macy Found'n, City College, NY							
kathryn - Kathryn Stroud, ETC							
madell - Rob Madell, Children's Television Workshop							
lornie - Lornie Bullerwell, Dedham High School							
edan - Ed Daniels, Framingham South High School							
nancy - Nancy E. Clark, Bristol-Plymouth Reg.Tech.							
brook - William Carnicelli, Ashland High School							
rader - Richard Rader, St. Mark's School							
alanb - Alan Bernstein, Cambridge School of Weston							

For each person, please check one category on each scale.

When I FIRST logged on to the network, to me this person was:
ACQ: O:unknown   N: I knew by name only   S:knew by sight, never talked
    T-:had talked <5 mins. T+:had talked >5 mins.
EXP: E:a known expert   P: possibly a known expert, or not a known expert

---

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
dickl - Dick LaCivita, Attleboro High School	--	--	--	--	--	--	--
murraya - Alfred Murray, Natick High School	--	--	--	--	--	--	--
vicki - Vicki Diez-Canseco, Newton North High School	--	--	--	--	--	--	--
djo - David Olney, Lexington High School	--	--	--	--	--	--	--
megs - Margaret Stenerson, Brockton High School	--	--	--	--	--	--	--
judah - Judah Schwartz, ETC	--	--	--	--	--	--	--
joedi - Joseph Dignam, Fitchburg High School	--	--	--	--	--	--	--
paulgir - Paul Girard, Salem High School	--	--	--	--	--	--	--
bill - Bill Barnes, Concord-Carlisle High School	--	--	--	--	--	--	--
bills - William Soule, Weymouth North High School	--	--	--	--	--	--	--
julie - Julie Rabschnuk, Ware High School	--	--	--	--	--	--	--
quesnel - Mary Anne Quesnel, Westport High School	--	--	--	--	--	--	--
frank - Frank Finigan, Winchester High School	--	--	--	--	--	--	--
sburt - Susan Burt, Marlinton School, Pocahontas, WVa.	--	--	--	--	--	--	--
chris - Chris Hancock, ETC	--	--	--	--	--	--	--
mandin - Ellen Mandinach, Educational Testing Service	--	--	--	--	--	--	--
rob - Rob Lippincott, WGBH	--	--	--	--	--	--	--
bonnie - Bonnie Brownstein, Schools of the Future, NY	--	--	--	--	--	--	--
jt - Joyce Tobias, Brookline High School	--	--	--	--	--	--	--
pat - Pat Butler, NIE	--	--	--	--	--	--	--
boris - Boris Rotman, Dep't of Biology, Brown Univ.	--	--	--	--	--	--	--
steve - Steve Roffman, Columbia University	--	--	--	--	--	--	--

APPENDIX E

Subject Matter Taught by Network Teachers

Appendix E

Subject Matter Taught by Network Teachers

	Teach Currently		Taught in Past	
	n	%	n	%
Chemistry	21	42	27	55
Biology	15	31	22	45
Physics	14	28	21	43
Physical Science	7	14	17	34
Earth Science	8	16	11	22
Computing	6	12	6	12

APPENDIX F

Sample of Network Messages, April 7-13, 1986

Mr. Jones, Professor of Chemistry and Lab Safety consultant from Any College has joined us as a guest on the Network.
He plans to visit all forums, but most discussion will take place in the chemis forum. Even if you do not teach chemistry, please be sure to visit the chemis forum for discussions of lab safety.

The litreview forum has been changed to make it more useful to Network members. Participants in the forum now have the option of following a format for entries (see message in litreview re: message format).

Each subject matter forum now has a message which lists Network members who are currently teaching that subject. There is also a list in NB of subjects that are not represented by forums and the members who teach those subjects.

Mr. Johnson, one of the developers of the PBS program series PLANET EARTH, has joined us on the Network as a guest. Please visit the PBSEARTH forum for further information.

```
maggie > scout

 physics  6         nb  3    system   1
   caldr  4       soft  0    halley   1
earthsci  0       terc  1  teaching   1
pbsearth  0  litreview  3      biog   0
 biology  2     chemis 11
```

MESSAGES FROM THE PHYSICS FORUM

from fred
to physics
attached: 2344
re: static electricity
Here's another message on static electricity...

> msg no. 2344 filed 8:37 PM Apr 6, 1986
> from frank
> to johnson fred tim ed
> re: static electricity
> I sent something on this before, but it well may be the glass\silk difficulty is due, as someone else suggested, to the "tiredness" of the silk. Not a very scientific term, admittedly, but I mean as the silk had been used over a number of years, the spaces between its fibers may become filled with little bits of dust and crud from the rods, from hands of students, etc. How about putting the silk through the laundry? Maybe that would help.

msg no. 2354 filed 11:07 AM Apr 7, 1986
from sandy
to physics
re: LIST OF TEACHERS WHO ARE CURRENTLY TEACHING PHYSICS

List omitted to preserve the anonymity of subjects.

msg no. 2412 filed 12:03 PM Apr 11, 1986
from jones
to physics earthsci biology chemis
re: lab safety literature
The Laboratory Safety Workshop has a bibliography of recommended materials for your safety reference library (every school should have one). If you would like to have free copy, please send a request with a self-addressed envelope to Laboratory Safety Workshop, Any College, Any Town.
Attention: Jones

Every school, as part of laboratory safety program, should have a reference library of laboratory safety materials.

One new release is the "Rapid Guide to Hazardous Substances" by Lewis and Sax. It's published by Van Nostrand and Lab Safety Supply had it advertised for about $16.50. It contains brief information on 700 chemicals. This is the source of my comments on para-dichlorobenzene to be found only in the Chemistry Forum.

msg. no. 2419 filed 2:22 PM Apr 11, 1986
from jones
to physics chemis
re: electrical safety
How many of your labs have ground fault interrupters on the circuitry?

One of the teachers who attended our workshop on laboratory safety told a story about a former student. She got married and had a child. Her husband was bathing the baby in the bathroom sink. His electric razor fell into the silk and electrocuted the baby.

Maybe, if schools had GFI's and taught students about their importance, this tragedy could have been prevented.

I've heard many stories about students sticking things in the electric outlets in science labs. Keep the power off when they are not in use. Seriously consider getting GFI's to replace the just one receptacle unit ($15-25) as an important precaution.

Additional information - read the chapters on electrical safety in the "Handbook of Laboratory Safety by Norm Steere from CRC Press (cost about $60).

msg no. 2421 filed 3:40 PM Apr 11, 1986
from tammy
to physics
re: static electricity
Yet another suggestion on the subject. If you rub an ordinary plastic ruler (the dime store variety) with plastic wrap (Saran, etc.) the ruler will become positively charged. If you rub the same ruler with wool cloth the ruler will become negatively charged. The charge can be demonstrated by hanging the ruler by a thread attached to the midpoint, and then bringing another charged ruler near one end. The rulers come conveniently punched with holes to fit a three-hole, so hanging them is easy. I've found this demonstration works like a charm even in damp weather. It's particularly nice because it shows so many things. You can show, for example, that when the ruler becomes positively charged, the Saran wrap becomes negatively charged, thus demonstrating charge conservation. Hope this will be helpful to someone.

msg no. 2443 filed 8:39 PM Apr 13, 1986
from wendy
to physics
attached: 2145
re: teaching candidates
Please see my message in the teaching forum.

Wendy

> msg no. 2145 filed 7:49 PM Mar 23, 1986
> from wendy
> to teaching
> re: New Teachers
> If anyone has a position to fill in chemistry, biology, physics or mathematics, please let me know. The Harvard Midcareer Math and science teacher training program will graduate around 15 students this spring. Around 10 are in math, 3 in biology, 1 in chemistry and 2 in physics. I will be delighted to talk with you about the program or the individuals. Many of the candidates in this program have significant experience working in the fields in which math and science is applied and hence present a mature, well educated candidate for teaching; many will hold certification in more than one field.
>
> Also please note that these folks will be finishing their student teaching early in May (the 4th I think) and thus will be a resource in case you need substitutes during the last few weeks of school.

The best way to contact these individuals in through my office at 555-5555 in Cambridge. Also, you may leave messages for me on the Network. My name is Wendy.

MESSAGES FROM THE BIOLOGY FORUM

msg no. 2412 filed 12:03 PM Apr 11, 1986
from jones
to physics earthsci biology chemis
re: lab safety literature

The Laboratory Safety Workshop has a bibliography of recommended materials for your safety reference library (every school should have one). If you would like to have free copy, please send a request with a self-addressed envelope to Laboratory Safety Workshop, Any College, Any Town.
Attention: Jones

Every school, as part of laboratory safety program, should have reference library of laboratory safety materials.

One new release is the "Rapid Guide to Hazardous Substances" by Lewis and Sax. It's published by Van Nostrand and Lab Safety Supply had it advertised for about $16.50. It contains brief information on 700 chemicals. This is the source of my comments on para-dichlorobenzene to be found only in the Chemistry Forum.

msg no. 2408 filed 12:30 AM Apr 11, 1986
from rich
to debbie biology
re: horticulture
Here is a list of topics in our Horticulture Course
1. Class Intro
2. Growth Medias
3. Plant Potting-Suggestions
4. Lab Work- Potting Plants, Preparing Soils
5. Fall Yard and Garden Work
6. Bulbs, Dividing and Transplanting Perennials
7. Fertilizers
8. Plant and Flower Arranging
9. Vegetative Propagation
10. Stem Cuttings
11. Aerial Layering
12. Forcing Bulbs
13. Collecting Tubers
14. Storage and Preserving of Seeds
15. Field Trip Northeastern U. Greenhouse
16. Seed Propagation
17. Germination Techniques

18. Lab Work-Planting Seeds
19. Guest Speaker- Greenhouse Owner
20. Growing Plants Under Lights
21. House Plant Identification and Characteristics
22. Lab Work-Techniques for Raising Flowering and Foliage Plants
23. Rock Gardens, Flower Beds, and Home Landscaping
24. Annuals and Perennials
25. Soil Testing
26. Growth Regulation
27. Pesticides
28. Labs on the 3 Above
29. Terrariums and Dish Gardens
30. Vegetable Gardening
31. Ordering Catalogues-Starting Seeds
32. Greenhouses and Cold Frames
33. Visit Wellesley College Greenhouse

Hope this gives you some ideas.

MESSAGES IN THE NB FORUM

msg no. 2355
from sandy
to nb
re: List of Members Who Teach Subjects Other Than Those in Forums

List omitted to preserve the anonymity of subjects.

msg no. 2386 filed 3:14 PM Apr 9, 1986
from dan
to nb
re: PHYSICAL SCIENCE SUMMER SCHOOL TEACHING POSITION
ANYONE INTERESTED IN TEACHING A 4 WEEK (7/7 - 8/1) SUMMER SCHOOL COURSE AT ANY HIGH SCHOOL PLEASE CONTACT DAN VIA THIS NETWORK OR CALL (555) 555-5555 FOR DETAILS

msg no. 2401 filed 9:00 PM Apr 10, 1986
from ron
to nb
re: IPS TEACHERS

WANTED ! SOME NEW SLUDGES FOR THE SLUDGE TEST, RANGING FROM EASY TO DIFFICULT. THE SOONER THE BETTER. THANKS.

PLEASE SEND IN NB TO RON.

msg no. 2395 filed 1:40 PM Apr 10, 1986
from fred
to nb
re: manual revisions
Thanks to all the members who volunteered to look at the manual for us. I'm happy to say that we have plenty of readers now, so we don't need any more. The new manual will be available to those who request it in a month or so.

MESSAGES FROM THE TERC FORUM

msg no. 2383 filed 12:31 AM Apr 9, 1986
from fredm
to terc
re: MBL AND LOGO
I would like to see Logo and a unit on simple machines connected somehow with mbl. Would also like more information on mbl conference at the end of May, especially workshops involving making the probes.

MESSAGES FROM THE LITREVIEW FORUM

msg no. 2371 filed 10:05 PM Apr 7, 1986
from andrew
to litreview
re: The Cosmic Inquirers: Modern Telescopes and Their Makers
The Cosmic Inquirers: Modern Telescopes and Their Makers, by Wallace Tucker and Karen Tucker, Harvard University Press, printed April, 1986, 256 pages.

"The enormous progress of astronomy in the past two decades is in large measure due to the development of new types of telescopes that operate both on earth and in space. The Tuckers have compiled personalized histories of five large projects that have already made or will make contributions to our understanding of the universe." The projects written about are: the VLA radio telescope, the Einstein X-ray Observatory, the HEAC-3 gammaray experiment, the infrared astronomy satellite, and the Hubble Space Telescope. "The scientific rationale for each project is clearly explained, and the 'people' stories give added appeal." Library Journal, April 1, 1986, page 156.

msg no. 2393 filed 1:30 PM Apr 10, 1986
from sandy
to litreview
re: message format

The following is a suggested format for Litreview entries. When you enter your re: line, please be sure to enter the subject and topic as follows:

subject - topic   for example   physics-vectors

Entering the re: line this way will allow members to search for members with similar interests. As with entries in other forums, please don't become overconscious of misspellings, sentence structure, etc. Entries are not meant to burden the writer by being formal, lengthy, or overstructured. This outline is meant to serve as a reference only -- reviewers should feel free to stray from this form and write reviews as brief or as long as they wish.

HERE IS THE SUGGESTED FORM:

1. REFERENCE
2. BRIEF SUMMARY OF THE ARTICLE OR BOOK
3. COMMENTS
   A. WHAT DID YOU LIKE ABOUT THE ARTICLE OR BOOK?
   B. WHAT DID YOU DISLIKE?
   C. WHAT DID YOU LEARN?

      a. DID YOU?

         Get any new teaching ideas? What were they? Learn any new developments in science? What were they? Find a "tidbit" of great information? What is it?

4. WHAT QUESTIONS DO YOU HAVE AFTER READING THE ARTICLE OR BOOK?

msg no. 2410 filed 12:32 AM Apr 11, 1986
from rich
to litreview
re: plant-Propagation
This is in response to the question of a book for a practical Horticulture Course. The book we used at CHS is Plant Propagation by Hudsen T. Hartman and Dale E. Kester. The publisher is Prentice Hall in 1959. The book has many illustrations and is divided into five major sections devoted to general aspects of propagation, special methods of propagation, and the propagation of selected plants. The book is about 650 pages long and there may now be a new version out. I would say the reading level is fairly high, maybe grade 11 or 12. It may be better as a reference book for your classes.

MESSAGES IN THE CHEMIS FORUM

msg no. 2353 filed 10:52 AM Apr 7, 1986
from sandy
to chemis
re: LIST OF MEMBERS WHO ARE CURRENTLY TEACHING CHEMISTRY

List omitted to preserve anonymity of subjects.

msg no. 2367 filed 7:56 PM Apr 7, 1986
from frank
to carol chemis
re: summer chem opportunity
Any College in Anytown, Michigan, has an NSF grant to do a program for 2nd year chem teachers, adv. class, or AP people. Honest to goodness real NSF program with $1000 stipend, + travel, + others. Runs June 23 to July 25. Yes June 23 is early, but schools in the midwest do not mess around with "winter" vacations in Feb. and "spring" vacations in April. I got a blurb on it, maybe you did, too. Application deadline is something like April 16... but they want a geographic spread, which means they would perhaps welcome people from New England. Love to go myself, but probably can't. If you want a copy of the blurb leave me a message. I check in most every day. My modem is compatible with the school IIe and with home IIc. I wouldn't worry overly much about the 4/16 deadline. They do want their geo. spread and I think it likely any Mass. address would swing a little weight in Michigan. Let me know.

msg no. 2370 filed 9:56 PM Apr 7, 1986
from andrew
to brian chemis
re: public domain software
Brian,

I have come across another source of public domain software that may be of help to the person who asked about ecology software.

Any Company
Any Street
Any Town, Any State

24 hour recording tells all 555-555-5555

has 1000's of useful programs to RENT or COPY.

msg no 2391 filed 11:22 AM Apr 10, 1986
from jones
to john chemis
re: fume hoods

One simple way to check the efficiency of your fume hood is to use a small piece of tissue paper (1" x 9"). If the air flow pulls it back to at least a 45 degree angle, the flow is sufficient.

I have an inexpensive Vaneometer (Dwyer Co.) that can make more accurate measurements. It costs about $40 and can be purchased from either Dwyer Co. or Lab Safety Supply Company in Janesville, Wisconsin. I would be very happy to loan you mine.

msg no. 2392 filed 11:40 AM Apr 10, 1986
from jones
to john chemis
re: heavy metal wastes

High schools have a definite problem with disposal of all kinds of chemicals. It's probably the one area that receives more requests for help than any other. Here are a few suggestions:

1. Get a copy of "Prudent Practices for Disposal of Chemicals from Laboratories" from the National Academy Press for $16.50.

2. Get a copy of "Less is Better", "RCRA and Laboratories", and "Hazardous Waste Management" from the American Chemical Society. They are all free.

3. Keep your wastes separated and store the heavy metals until suitable disposal methods or recovery become possible. An interesting honors project might be to try to recover the metal or to make something "useful" out of it.

4. The House Bill 301 is now being considered to help schools dispose of wastes (hazardous). Contact your state reps for more information and to be sure that High Schools get included in this legislation.

5. I'm working on a disposal project. I'm trying now to find a sponsor to put-up the funding for school disposal on a one time basis. More new on this when there's some success to report.

msg no. 2411 filed 11:54 AM Apr 11, 1986
from jones
to frank chemis
re: chemical storage
Frank- The system proposed by the Flinn Scientific Co. is a good one. It groups chemicals by anion rather than alphabetically. This avoids having incompatible chemicals next to each other on the same shelf. Their computer inventory also seems to offer some real benefits.

However, their disposal suggestions are not always environmentally sound and you should check before following their directions.

Concerning chemical storage:

1. Storage Systems - Flinn is the only new system to come along. The major problem in stockrooms is over crowding. Most labs are very crowded - often with storage 3 to 6 deep.. it's pretty tough to know what you've got in the back or to reach it without having a problem.

2. Security - keep it locked at all times. Students will steal chemicals and almost anything else that's not tied down (balances, etc). There's real liability issue here with unlocked, unsecured chemical storage areas. I recommend the use of "stockroom locks" and automatic closers on the doors.

3. Ventilation - the recommended specification is one cubic foot of air per minute per square foot of floor space. The minimum should be 150 cubic feet per minute.

4. Fire Protection - explosion proof lighting is recommended and so are heat detectors and extinguisher systems.

5. Additional reading -

a. Storage and handling of chemicals by Pititone published by John Wiley

b. Fire Protection for Laboratories Using Hazardous Chemicals published by National Fire Protection Association (NFPA) about $5.

msg 2414 filed 12:17 PM Apr 11, 1986
from jones
to chemis
re: waste disposal
I had a number wrong for the legislation I mentioned last time. The correct title is State Bill 310CMR. It applies only to cities and towns and you should contact your state rep to have schools included.

msg no. 2419 filed 2:22 PM Apr 11, 1986
from jones
to physics chemis
re: electrical safety
How many of your labs have ground fault interrupters on the circuitry?

One of the teachers who attended our workshop on laboratory safety told a story about a former student. She got married and had a child. Her husband was bathing the baby in the bathroom sink. His electric razor fell into the silk and electrocuted the baby.

Maybe, if schools had GFI's and taught students about their importance, this tragedy could have been prevented.

I've heard many stories about students sticking things in the electric outlets in science labs. Keep the power off when they are not in use. Seriously consider getting GFI's to replace the just one receptacle unit ($15-25) as an important precaution.

Additional information - read the chapters on electrical safety in the "Handbook of Laboratory Safety by Norm Steere from CRC Press (cost about $60).

msg no. 2412 filed 12:03 AM Apr 11, 1986
from jones
to physics earthsci biology chemis
re: lab safety literature
The Laboratory Safety Workshop has a bibliography of recommended materials for your safety reference library (every school should have one). If you would like to have free copy, please send a request with a self-addressed envelope to Laboratory Safety Workshop, Any College, Anytown. Attention: Jones

Every school, as part of laboratory safety program, should have reference library of laboratory safety materials.

One new release is the "Rapid Guide to Hazardous Substances" by Lewis and Sax. It's published by Van Nostrand and Lab Safety Supply had it advertised for about $16.50. It contains brief information on 700 chemicals. This is the source of my comments on para-dichlorobenzene to be found only in the Chemistry Forum.

msg no 2413 filed 12:10 PM Apr 11, 1986
from jones
to chemis
re: p-dichlorobenzene
Someone raised the question about p-dichlorobenzene. According to Sax and Lewis "Rapid Guide to Hazardous Chemicals" the material is moderately toxic and can cause injury to internal organs. Prudence dictates that you should keep exposure to a minimum.

Use in a fume hood or very well ventilated room. The TLV (Threshold Limit Value) is 75 ppm.

Concerning the observation about it being safe because it's available over the counter ----

So is gasoline, draino, plumers helper, and oven cleaner!

msg no. 2439 filed 9:21 PM Apr 12, 1986
from frank
to chemis
re: sociology of electrons
Anybody want to talk about this. My latest personal definition of chemistry is "The Sociology of Electrons". There are species that demand to have them, flourine, e.g.; others that just as strongly strive to get rid of them, lithium, maybe. And many species that can take them or leave them: transition metals, C, N, S, etc.

There are rules governing these behaviors, empirical for the most part, like sociology. Octet rules, electronegativity, enthalpy change, free energy change, entropy, and the electrode potentials for redox reactions.

There are numberless herds of these electrons and their behavior is governed only by statistical laws (with their inherent exceptions). And I'm not talking about the statistics of quantum stuff because I don't know all that much about that.
So what, and who cares? It happens that my wife is a sociologist, so I care. I teach chemistry, my first love, and physics. I find in my department, and most of my colleagues agree, that chemistry is the single most difficult subject to teach. So cerebral! You're never going to see those electrons, those atoms, or those bonds. Physics, while usually considered conceptually demanding, is far easier to teach because so much of it can be built upon prior experience of students in front of you. They already know about mass (call it "weight" maybe), speed, distance, and time. A physics teacher can build on this. But a chemistry teacher? Has to deal with the unknown and the unseen -- and it will forever be unseen. So...the Sociology of Electrons. Haven't even yet discussed this with my wife-sociologist. I'm sure she'll have some input. Anybody want to talk about it? Glad to hear from you.

MESSAGES FROM THE SYSTEM FORUM

msg no. 2356 filed 11:46 AM Apr 7, 1986
from fred
to john system
re: "pause is set off"

If you see a message when you log in saying that pause is off, it means that you will not get automatic screen pauses between messages. This is because sometime in the past you

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     set pause off
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perhaps for purposes of downloading, and never set the pauses back on. The message comes out because if pause is off and you don't want it to be off you can be inconvenienced. For example, if you set pause off and then visit nb, say read all, you'll have to sit through a lot of messages with no way to escape. Pressing CTRL O will help a bit, but the program (as currently written - I may improve it) will still chug internally through all the messages in the forum. If you want screen pauses back on type

```
     set pause on
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MESSAGES IN THE HALLEY FORUM

msg no. 2400 filed 6:36 PM Apr 10, 1986
from frank
to halley
re: ta ta
Goodbye. Sorry you weren't much of a show in my lifetime! Only hope the probes got some good info.

MESSAGES IN THE TEACHING FORUM

msg no. 2446 filed 11:08 PM Apr 13, 1986
from andrew
to teaching
re: new teachers
Wendy,

When I saw your message a few weeks ago, I passed it on to our superintendent of schools, Mr. Smith, for his reference. I do not know our staff requirements for next year (doubt any new jobs). However, I think our school system is always looking for subs. Anytown is close to Harvard. I hope Mr. Smith can use your source of manpower. It could lead to a job at some time because of a retirement or a resignation. You could follow-up mu note will a phone call to Mr. Smith.